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Non-Human Primates of India



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Wildlife Institute of India



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The Environment Information System (ENVIS) Centre at the Wildlife Institute of India, set up in September 1997, is part of the ENVIS set-up of the Ministry of Environment and Forests, Government of India. It deals with general matters concerning 'wildlife' and specifically those related to 'protected areas'. Its objectives are to:

- * Establish a data bank on information related to wildlife and wildlife protected areas, and thereby build up a repository and dissemination centre for information on wildlife science;**
- * Promote national and international cooperation, and exchange of wildlife related information;**
- * Provide decision makers at the apex level with information related to conservation and development.**

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Non-Human Primates of India

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Directors Note

This issue of ENVIS deals with non-human primates that belong to the highest mammalian order—Primates. Evolutionarily, biologically, and culturally, non-human primates are the closest relatives of humans. A shared ancestry with humans is responsible for many common characteristics in non-human primates—tool use, long-lasting social relationships, physiological characteristics, etc. The association between human and non-human primates has been close and intricate, more so in the Indian subcontinent due to the emotional and poignant coalescing of non-human primates with Hindu mythology. The study of non-human primates has also contributed to the understanding of basic biological phenomena, human diseases, social behaviour, and life-styles of human societies. Non-human primates, comprising monkeys, langurs, apes, lemurs, and lorises, etc. inhabit most part of the biodiversity rich, 4 major biogeographical tropical and sub-tropical regions of the world. They perform ecological services such as seed dispersers, pollinators, primary consumers, and as food for top predators. They are, therefore, good indicators of the general health of the ecosystem and are helpful in conservation planning.

With 63 genera and 620 species/subspecies, non-human primates are represented in about 92 countries, Brazil topping the list with 77 species. A total of 21 species are recorded from the Indian subcontinent including Sri Lanka. India with 15 species is notable more for their abundance, commensalism, and diversity of habitat across the length and breadth of the country. None of the wildlife species is as indicative of the two 'hot-spots' in India as non-human primates are with their concentration and endemic status in and around the Northeastern Himalayas and the Western Ghats.

Compared to their very vital and important roles in sustaining the biodiversity rich tropical and sub-tropical habitat of the country, non-human primates have received very little or no attention from researchers, conservationists, and planners. The recent spurt in man–monkey conflict cases, involving a few commensal primate species, has added further to their tribulations. The conservation threat, which was hitherto limited only to those non-human primate species that were fast losing their wild habitat, has now swathed even these commensal species.

The age-old cultural and religious fervour to protect the '*Hindu god*' is quickly giving way to hostility and antipathy.

Although 9 out of 15 non-human primate species are included in Schedule I(1), and the remaining 6 in Schedule II(II) of the Wildlife (Protection) Amendment Act, 1991, yet, there seems to be no let-up in their conservation threat perception. The colossal information gap and dearth of proper database on taxonomy, ecology, behaviour, and conservation issues for most of the non-human primate species in India is the main reason why authorities have not been able to take proper conservation measures. The Wildlife Institute of India has been a pioneer in initiating detailed *in situ* and *ex situ* studies on some of the highly endangered

primate species, and continues to conduct such studies as regular annual research activities. This ENVIS issue on 'Non-Human Primates of India' is yet another landmark attempt in furthering the cause and concerns of this fascinating group of animals, whose study is directly linked with the welfare of the human society. Further, conservation of a natural ecosystem at a landscape level should be considered for reducing the man–monkey conflict.

The next issue of ENVIS will be dedicated to 'Mountain Ungulates' to commemorate the 'YEAR OF THE MOUNTAIN—2002'.

S. K. Mukherjee
Director, WII and Team Leader,
ENVIS Centre
Wildlife Institute of India

Mailbag

सारगर्भित, सुस्पष्ट, बहु-उपयोगी,
तथ्यपरख, उत्कृष्ट एवं त्रुटिरहित
बुलेटिन मुद्रण के लिए आप
साधुवाद के पात्र हैं।
समस्त जीव-जन्तु, पादप जगत्
का सेवाभाव से सृजित बुलेटिन
निःसन्देह संग्रहणीय, पठनीय,
उल्लेखनीय है।

नवल डागा
कृषि व्यवस्था
366, जौहरी बाजार,
जयपुर—3

Extract of letters in
response to vol.2, no.2

This directory has fulfilled a long standing demand by wildlifers and environmentalists.

Shri I.S. Negi, Honorary Secretary,
Wildlife Preservation Society of India,
7, Astley Hall, Dehradun

Congratulations on a most useful Bulletin—
such a directory was surely needed.

Mr Ashish Kothari, Kalpavriksh, Apartment
5, Shree Dutta Krupa, 908, Deccan
Gymkhana, Pune 411 004

This is a most useful compendium of
information on Wildlife Protected Areas in
India. It is well documented, excellent,
informative and provides valuable information
on the present scenario and is useful to
researchers, reference libraries, the media
and educational institutions.

Prof. Dr S.P. Bhatnagar, Wildlife
Conservation Society of India, A-51,
Mansarovar Colony, Vaishali Nagar,
Ajmer 305 001 (Rajasthan).

This is indeed a very useful directory and will
be of immense help to students, research
scholars, faculty of wildlife departments and
managers of protected areas. I extend my
congratulations to all concerned in bringing out
such an useful compilation. I hope the WII will
continue publishing books/manuals on relevant
topics of wildlife studies and conservation in
the country.

Prof. H.S.A. Yahya, Chairman, Department
of Wildlife Sciences, Aligarh Muslim
University, Aligarh 202 002.

My heartiest congratulations to you all for
bringing out the Directory of Wildlife Protected
Areas in India. It brings together in one place
the status of these areas. This is a publication,
which should be available practically with every
Deputy Conservator of Forests and other
senior officers. I quite understand the
limitations, nevertheless you may please think
on these lines and maybe make it available to
all the officers, if need be as a priced document.

Dr S.N. Rai, PCCF (Working Plan &
Research), Aranya Bhavan, 18th Cross,
Malleswaram, Bangalore 560 003

I would like to congratulate all those who have
put in hard work in collecting the desired
information from far and wide. This is the first
directory of Wildlife Protected Area Managers
and will be of immense help to all those who
are interested in Wildlife Conservation. I
congratulate each and everyone associated
with the publication of such a comprehensive
and informative bulletin.

Mr C.L. Bhatia, IFS, Director
General of Forests & Special Secretary to
the Govt. of India (Retd.), 143, Uday Park,
New Delhi 110 049

Congratulations on this contribution to
facilitating communication related to India's
protected areas. At a first glance, we thought
you had neglected to include the names of the
managers, but then reading your introduction,
realized why you have not included the names
in the printed version. We have not tried to look
up the bulletin on your website yet, but think
that your attempt to keep the names current in
the electronic version is a noble attempt.

Mr Dave Ferguson, Fred Bagley, Jarl
Stromayer, Kimberly McClurg,
Division of International Conservation, US
Fish & Wildlife Service

I just wanted to say that the recent production
from WII's ENVIS programme is extremely
impressive. The Directory of PA Managers is
one of the most useful compilations that I have
seen of late. Congratulations and keep up the
good work.

Shri Vivek Menon, Executive Director,
Wildlife Trust of India, C-644,
Second Floor, New Friends Colony,
New Delhi 110 065

This issue is updated, excellent, informative
and provides valuable information of contact
addresses of the network of National Parks
and Wildlife Sanctuaries of India. The State-
wise information on wildlife protected areas in
India, Principal Chief Conservator of Forests,
Chief Wildlife Wardens and Project Tiger
Reserves is also highly appreciable. The maps
are also an added asset for understanding the
actual locations of the existing National Parks
and Wildlife Sanctuaries. Your decision to
compile, collate and publish such a high value
material is really commendable. I am sure, with
the dedicated team of workers you have, the
data collected by you for bringing out this
valuable publication will become a standard
reference for its users.

Shri A.P. Dorlikar, 20, Surve Layout,
Behind Sanjuba High School,
PO: Ayodhyanagar,
Nagpur 440 024

The current Directory of Wildlife Protected Area
Managers is a completely different kind of a
book. This Directory is a most impressive and
useful volume. First of all, although it contains
much information, it is a 'handy' size (half A4
or 8 x 5.5). It is also very attractively typeset
with black side borders containing the names
of the states so that it is very easy to find the
information you want. There are maps of each
state with the location of each NP and PA
clearly marked on them. One hopes the
managers will provide WII with the information
of their postings so that the internet version is
kept up-to-date. This is a most useful service.

Sally Walker
Zoo Outreach Organization,
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Peelamedu, Coimbatore,
Tamil Nadu 641 004 India

Non-Human Primates of India: An Introduction

A.K. Gupta

Classified under the same Natural Order as man, non-human primates, which include apes, monkeys, lemurs and langurs, have always excited man's interest. They are one of the most fascinating groups of animals. Vocal, group living, and diurnal, primates are easily seen in a forest which makes them more popular than other mammals. The study of non-human primates has a close bearing on the understanding of human, social and psychological problems. Their study is also important in the field of medicine (human and veterinary) and agriculture (protecting crops from primate pests). Biologically, primates provide an understanding of the morphological, physiological, and even behavioural aspects of human evolution, especially of early man before the advent of agriculture (Roonwal & Mohnot, 1977). Primates are also good indicators of the health of an ecosystem, a property that can be used for the appropriate conservation planning of the given ecosystem.

Origin and Evolution of Primates

(Adapted from Fleagle & Reed, 1999)

Primates constitute the highest order of mammals from the evolutionary point of view. Fossils of primates have been found in Europe and North America. Australia, the adjacent islands of New Guinea and the islands of Oceania in the Pacific are the only places with

no evidence record of primates (Roonwal & Mohnot, 1977). The first living members of the order of primate date back to approximately 55 million years ago (mya) at the beginning of the Eocene Epoch. They were more similar to the extant prosimians—the tarsiers of Southeast Asia and the strepsirrhine primates (lemurs and lorises) of Madagascar, Africa and Asia, in many adaptive features and phylogenetic affinities. Eocene primates were small, with most species less than 1 kg in estimated mass, and only a few as large as 5 kg. They included diurnal and nocturnal, largely insectivorous and frugivorous, as well as quadrupedal and leaping varieties. Anthropoid primates first appeared in Northern Africa and Asia in the early part of the Oligocene Epoch (35 mya). They were comparatively larger in size and showed a diversity of dietary and locomotor adaptations. They were mostly frugivorous and seed eating, few if any were folivores, and all were arboreal and leapers. Fossil platyrrhines in South America, hominoids (apes), and Old World monkeys in Africa first appeared in the beginning of the Miocene (23 mya) Epoch. The end of the Miocene and the beginning of the Pliocene Epoch (5 mya) is marked by the major radiation of Old World monkeys in Africa and Eurasia. In Asia, tarsiers, lorises and anthropoids have been distinct from one another for 50 million years or more. The



divergence between apes and monkeys took place approximately for 25 mya, and between colobines and cercopithecines for about 15 mya. The lesser apes diverged from orangutans more recently (18 mya) and siamangs diverged from gibbons for about 10 mya. The different genera of leaf monkeys have been separate for a lesser time compared to macaques (Figure 1).

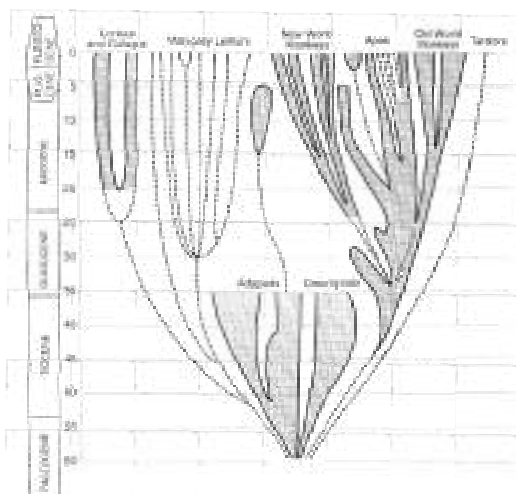


Figure 1. A geological time chart showing major events in primate evolution and the distribution of fossil primates throughout time and space (Fleagle, 1989).

Primates are best identified by a combination of characters rather than by one or more unique or exclusive ones. Having evolved from arboreal ancestors in general, they retain these characteristics; a few species have, secondarily returned to terrestrial habitat (Roonwal & Mohnot, 1977).

Taxonomy of Primates

Linnaeus listed primates as the first order of mammals and recognized four genera: *Homo* (man), *Simia* (monkeys and apes), *Lemur* (lemurs and lorises), and *Vespertilo* (bats). However, bats were later removed from the primates order (Mivart, 1873). After this first attempt to classify primates, there have been

many changes in the taxonomy of primates, the latest being Groves (2001). Still, some more changes are in the offing, especially concerning the taxonomy of the Asian primates (refer to the Sally & Molur paper, in this volume).

The genus *Lemur* consisted of the Ring-tailed lemur, *Lemur catta*, from Madagascar, and the Slender loris from Sri Lanka. In the present scheme of classification, they are now recognized in the sub-order Prosimii (Pre-or early-monkeys) as Lemuriformes (lemur) and Lorisiformes (loris). The Prosimii has 4 families, that are generally distinguished by their long noses terminating in a naked moist snout or rhinarium, and muzzle and brows with prominent whiskers (Napier & Napier, 1985). They are mostly nocturnal and arboreal. As an adaptation to a nocturnal life style, their eyes are set slightly sideways and they have a highly developed sense of smell and hearing. The Lemuriformes are exclusively from Madagascar and have 3 families: Lemnoidae (true lemurs and dwarf lemurs), Indridae (indri, propithecus, and avahi), and Daubentoidae (aye-aye). The Lorisiformes inhabit Africa and Asia and have only one family: Lorisidae (loris, pottos and galagos).

The genus *Simia* includes both apes and monkeys. 'Ape' refers to both the great apes (chimpanzee, gorilla, and orangutan) and the lesser apes (gibbon and siamang), that have long arms, broad chests, and no tail. Monkeys from the Old World (Africa and Asia) and the New World (South & Central America) have short (macaques) and long (langurs) tails. In the present form of classification, the sub-order Anthropoidea (man-like forms) includes both the *Homo* and *Simia* genera of Linnaeus. The sub-order Anthropoidea has 6 families. Anthropoids are characterized by short faces, dry noses, and lacking in prominent whiskers.

The infra-orders are recognized on the basis of the structure of the nose: Platyrrhini (broad flat nose). These are New World monkeys (South and Central America) with 2 families: Cebidae and Callitrichidae. The Catarrhini (narrow downward-facing nostrils) are the Old World monkeys (Africa and Asia) with 4 families: Cercopithecidae (monkeys and langurs), Hylobatidae (gibbons), Pongidae (greater apes), and Hominidae (man) (Napier & Napier, 1985) (Figure 2).



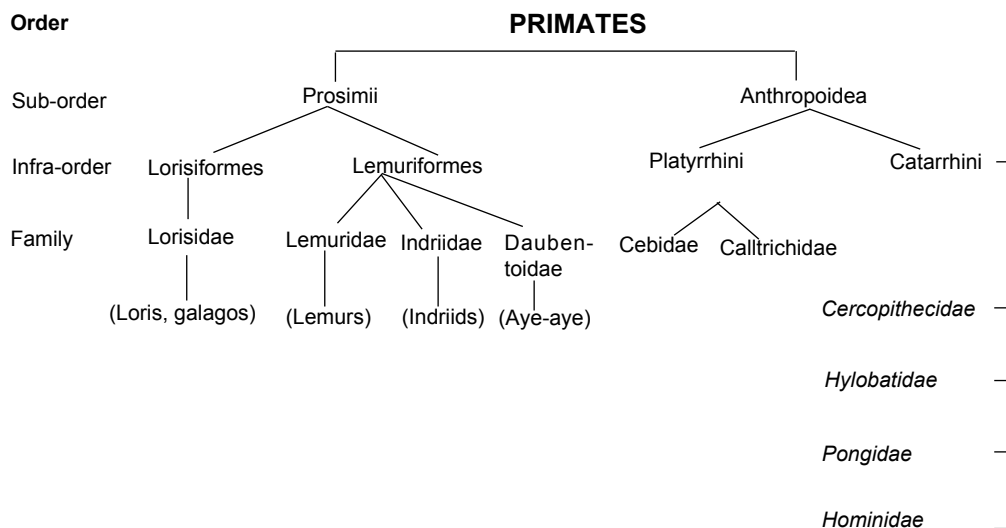
Figure 2. Worldwide distribution of primates.

Primates in the Tropical Ecosystem, Their Role and Uniqueness

Primates often perform ecological services that are important for the maintenance of tropi-

cal habitats: as seed dispersers, pollinators, and also as food for top predators, especially hawks, eagles and mammalian carnivores (Janson, 1983; Terborgh, 1983; Isbell, 1990). Loss of one or two species out of a primate community may lead to an extinction chain for a whole range of plant species (Myers, 1986). Therefore, the presence of ecologically diverse primate communities is essential for maintenance of the integrity of many tropical forests.

Primates, at places, constitute an important group of mammalian primary consumers. Figures averaging 1000 kg/km² are more common in the rainforests of Africa, Asia, and the neotropics (Bourlière, 1985). Primates are notable consumer of plants and, to a much lesser extent, of animal material. At the ecosystem level they exert a very important feedback control on the vegetation itself; they are essential to the maintenance of homeostasis of the forest ecosystem, especially critical for forest regeneration and survival. The role of primates in pollination is very discreet. A number of nocturnal and diurnal



primates (lorises, lemurs, and bushbabies) have been recorded feeding on nectar without destroying the flowers, and helping in pollination. (Sussman, 1978).

Primates contribute immensely in ensuring the dissemination of seeds of forest trees and lianas (zoochory), and also have a definite edge over other seed-dispersers due to larger home ranges and more numerous social-groupings than those of sympatric mammals of similar sizes. The 'flux' of viable seeds is also maximized as they consume the fleshy part of the fruit, rather than the harder stones (Hladik, 1969).

Primates are very similar to humans and the principal reason for this similarity is simple: humans are primates. Current ideas are that the first primates appeared more than 60 million years ago. In contrast, the common ancestor of humans and African apes lived only about 5–8 million years ago; so, for more than 50 million years, humans and African apes have shared primate ancestry. This explains why human and non-human primates have many characteristics in common—tool use, long-lasting social relationships, and complex communication systems. By learning about non-human primates we may come to learn more about ourselves.

Human and non-human primates also share physiological characteristics: the organization of rhesus monkeys and humans is similar; neuroanatomical studies of the non-human primate brain have been extremely useful in helping us to understand the functions of the human brain and how we are able to see. In this way, non-human primates serve as models of particular processes that would be extremely difficult or impossible to study in humans.

The study of non-human primates has also

contributed to our understanding of basic biological phenomena such as reproduction, of diseases such as AIDS; and to the development of drugs, treatments, and vaccines for the promotion of better health for human and non-human primates alike. In fact, some of the research conducted with non-human primates has been awarded the Nobel prize: development of the yellow fever vaccine (1951); culturing of polio virus that ultimately led to the polio vaccine (1954); and the significant discoveries in visual processing in the brain (1981).

Primates are also very fascinating animals. They live in a wide range of habitats, and exhibit many interesting differences in behaviour and life styles, the study of which is very similar to exploring the social behaviour and life styles of human societies.

Primates are also considered to be very good predictors of the richness of other mammalian fauna, and in absence of other inventory information, the species richness of primates at a locality is a useful indicator of the probable richness of the non-primate mammals (Emmons, 1999). In the neotropics, primate richness is correlated strongly with the richness of rodents and marsupials, but only weakly with that of bats and carnivores, and not at all with that of large ungulates. All taxa seem to increase with primate richness in Africa and Madagascar (especially non-flying mammals), but in Asia this relationship is very weak and even a doubling or tripling in the number of species of other mammals may not cause any increase in primate populations. Emmons (1999) also studied this relationship with individual orders of mammals and found that in Africa, bats, rodents, ungulates, and insectivores increase with primate species richness, but carnivores show little correlation;



for the neotropics, rodents and marsupials increase regularly with primates, bats more poorly, and carnivores and ungulates show no correlation; for Madagascar alone, all taxa show strong positive correlation; while for Asia it is very poor.

Primates have developed certain ecological traits that have contributed to the rapid evolutionary success of the order, especially in the tropical environment. The following traits are noteworthy (Bourlière, 1985).

(i) Preference for Predominantly Vegetarian Diet:

This allows the primates to make use of the most abundant energy source in their environment and, thus, to build up higher population densities than sympatric 'carnivorous' (tiger, leopard, lion, dogs) mammals of comparable size. This is a consequence of the well-known low efficiency of energy transfer between trophic levels within an ecosystem. This allows primates to reach population densities up to 9 times higher than those of secondary mammalian consumers such as bears, canids (dogs and jackals), or felids (big and small cats). This is of a definite demographic advantage.

(ii) Propensity for Arboreal Life: Arboreal primates are at a decisive advantage compared to most other primary consumers of similar body size, because they can make use of all edible plant materials—fruit as well as fresh leaves, gums, sap, and even barks in their tri-dimensional environment. They are not strictly confined to the grass and shrub layers, as ungulates (deer) are.

(iii) Opportunistic Tendencies: Primates are rarely the true 'specialist' feeders and most of them have varied food habits, supplementing their basically vegetarian diet with a variety of animal prey, particularly when their body size

is small. This enables their populations to adapt more effectively to a wide range of environmental conditions. This is particularly true in the families Cebidae (Cebus), Cercopithecidae (monkeys and langurs), and Pongidae (lesser and greater apes), where a small number of clever opportunists, eclectic in their tastes and displaying a strong tendency to omnivory, are able to take advantage of a variety of habitats and situations (*Cercopithecus aethiops*, *Semnopithecus entellus*, *Macaca mulatta*, *Papio anubis* and *P. ursinus* among baboons, and even chimpanzees among apes).

(iv) Extended Socialization Periods (mostly Monkeys & Apes): The high longevity of most of the primate species provides them with opportunities for an extended socialization in the form of developing 'social traditions' transmitted through generations, which further facilitate their adaptation to local situations.

Primate Habitat, Ecology, and Behaviour

Primates are naturally distributed on 5 of the 7 continents (except in Australia & Antarctica), inhabiting mostly tropical and subtropical regions. A few hardy primate species are also reported in the temperate regions (Japan, South Africa, langurs in Nepal, rhesus and Tibetan macaques in China, and barbary macaque in Morocco). Primates are not distributed at random in physically suitable environments, rather they tend to form communities (taxonomic assemblages of interacting populations living in a given area, usually with rather similar life habits). Each of these communities may be made up of a number of species which can themselves be grouped in a number of gross ecological categories or 'clusters of functionally similar species' (Root, 1967). The most commonly used ecological categories or 'guilds' are based on (a) the time of activity



of the species—nocturnal versus diurnal, (b) primarily arboreal or terrestrial habitats, and (c) their primary diet—frugivorous, folivorous, or insectivorous. Based on the above, the following 7 different primate guilds can be distinguished (Clutton-Brock & Harvey, 1977):

- Diurnal, arboreal, frugivorous (gums included)
- Diurnal, arboreal, folivorous
- Diurnal, terrestrial, frugivorous
- Diurnal, terrestrial, folivorous (grass included)
- Nocturnal, arboreal, insectivorous
- Nocturnal, arboreal, frugivorous (gums included)
- Nocturnal, arboreal, folivorous

Three major vegetation communities where primates dwell are: tropical forests (in areas with round the year high rainfall—1,500 to 4,100 mm), tropical grasslands, and the savannahs. Tropical forests consist of primary forests (undisturbed with proper stratification of canopy layers), secondary forests (disturbed/ modified due to biotic factors), swamp or mangrove forests, riverine forests (also known as gallery or riparian forests along the waterways), montane forests (cloud forests at 2,000–3,000 m), and monsoon

forests (seasonal with dry months and deciduous nature of trees) (Figure 3).

Forest habitats can further be divided into 4 different strata, which are preferred differently by different primate species (examples from Indian species):

Upper canopy: Hoolock gibbon, Stump-tailed and Lion-tailed macaque.

Middle canopy: Capped, Nilgiri, Common, Golden and Phayre's langurs, Assamese macaque.

Lower canopy: Slow and Slender loris, Pig-tailed and Long-tailed macaque, Common and Bonnet macaque.

Ground: Common langur, Rhesus, Bonnet and Crab-eating macaque.

Primates can also be distinguished by their ability to lead a commensal life in proximity with human populations. Those who can tolerate the presence of humans and do not express paranormal behaviour unless disturbed, are the commensal species (Rhesus and Bonnet macaques, Hanuman langur), and the rest are non-commensal or obligatory wild-habitat species. Due to severe biotic pressures and the resultant shrinking of the available habitat for some of the wild-habitat species, these are forced to lead a commensal life in proximity with human populations at some of their distribution ranges (Pig-tailed, Assamese and Crab-eating macaques).

The forest habitat used by primates are based on the dominance of tree species in the habitat, which fall broadly under the following 3 types:

Bamboo forests: These are mostly inhabited by Phayre's, Capped and Golden langurs, Hoolock gibbons, Slow and Slender loris.

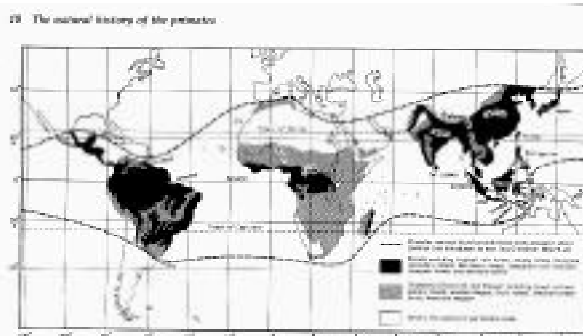


Figure 3. Distribution of vegetation zones within the range of non-human primates.

Broad-leaf forests: These are mostly inhabited by Capped and Phayre's langurs, Stump-tailed and Pig-tailed macaques, Lion-tailed macaques, Nilgiri langurs, Assamese macaques.

Fig forests: These trees form a very important dietary component for the following primate species—Hoolock gibbon, Stump-tailed and Pig-tailed macaques.

Feeding Ecology

Most primates are vegetarians. Some of them, however, do supplement their vegetarian diet with animal food (insects, mollusks, bird eggs, birds, and crabs). Soil eating is also common in certain species to fulfill their mineral deficiency. Generally, most primate species select their food from a wide variety of food plant species. These primates are referred to as 'generalist' feeders (Rhesus macaque, Hanuman langur, Bonnet macaque in India). 'Generalists' being also the commensal species, can withstand shortage of food in the wild. Some primate species, however, select their diet from very specific plants and their parts and are referred to as 'specialist' feeders. These primate species face grave conservation risk in the absence of desired habitat types carrying specific food items (gibbon, loris, most langurs, and Stump and Pig-tailed macaques in India).

Social Organization

Most primates live in groups of different sizes and varying social organizations. DeVore (1968) has identified 6 broad categories of social organizations:

- Solitary (usually nocturnal and crepuscular): lorises, tarsiers, galagos.
- Mated pair with offsprings: indris, galagos, marmosets, gibbons.

- Group with only 1 male: patas, gelads, some baboons.
- Groups generally oriented to 1 male: spider monkey, colobuses, some langurs, and gorillas.
- Group with multiple adults of both sexes: some lemurs, howler monkeys, savannah baboons, vervets, mangabeys, colobus, some langurs, geladas, chimpanzees.
- Unstructured aggregation: galagos, geladas, some baboons, chimpanzees.

The size and composition of a primate group is an intimate expression of its functional ecology, which might differ from place-to-place and season-to-season. In some species it is usual for the troop to split up during the day, forage either as individuals or as small bands, and then join up again at night. Such fission-fusion organization has important consequences for the social ecology of the species. Group sizes are important for two main reasons. Firstly, they can give an idea of social structure. Secondly, they can indicate disturbance levels; a smaller group size than the normal could be an indicator of the area being heavily hunted/degraded. Group size is not absolutely constant and may show seasonal fluctuations. Group (and sub-group) size may be related to foraging opportunities, habitat quality, and food availability. Group composition can be related to the size of the forest block. Some species travel in small bands of 5–6, other species move in groups numbering several hundred where some kind of hierarchical organization is observed (Dunbar 1987, Whitten 1988).

(For a detailed description on Primate Habitat, Ecology and Behaviour of Indian non-human primates, please refer to various articles in this volume).



Primate Diversity and Distribution

World

Non-human primates currently inhabit 4 major biogeographical tropical and sub-tropical regions (23°N and 23°S). Their presence is confirmed in about 92 countries from 4 major regions (South and Central America, Africa, Madagascar, and Asia), making up for a total of 63 genera having more than 620 species/subspecies (Table 1). Of these, about one-third are ranked as endangered. Some monkeys

general pattern in the distribution of individual primate species within each of the geographical range with respect to body size, diet, rainfall, and plant diversity. The most likely factors associated with the diversity of primate communities within different biogeographical regions could be: geological, biogeographical historical, availability of resources, competition with other vertebrates, and local extinction due to human activities. The patterns of ecological diversity seen today in primate fauna can best be explained through an understanding of their evolutionary history (Fleagle *et al.*, 1999).

Table 1. Global Distribution of Primates

Region	Genera (No.)	Species/Sub-species (No.)
South America	16	204
Africa	20	190
Madagascar	14	50
Asia	13	176
About 92 countries	63	620

are found in the eastern Temperate Zone (Japan and China) as well. The Barbary ape in Gibraltar is a relatively recent introduction (some time before 1704). The Sahara Desert, the Arabian Desert (except for a few coastal areas), the extreme western portion of the Thar Desert, and the southern part of South America are devoid of primates.

Of these regions, Africa has the highest levels of alpha diversity (the number of species in a community) found anywhere in the world with up to 17 species in some communities. Asian communities have the lowest maximum diversity with few communities having more than 8 sympatric species, while communities in Madagascar and South America fall between the two extremes. There seems to be no

India

India, being richly endowed by Nature in the diversity of physical environment (from the Indian Ocean to the lofty Himalayas and beyond to the cold deserts) and myriad climatic situations, is among the 12 Mega-Biodiversity countries of the world. India also has a great range of ecosystems being at the confluence of three Biogeographic Realms (centres of origin of life), viz. the Indomalayan, the Eurasian, and the Afrotropical. This provides India with 2 of the 18 unique bio-diversity 'hot-spots', (Northeast Himalayan and that of the Western Ghats) which are the storehouses of nearly 50,000 species or about 20% of the world's flora. As per the latest (1995) reports of the Botanical and Zoological Survey of India, there are nearly 45,000 species of plants in the country. Vascular flora, which forms the conspicuous vegetation cover comprises 15,000 flowering plant species of which 5,150 species (more than 33%) are endemic and have so far not been reported anywhere else in the world. About 1,500 endemic species face varying degrees of threat. Similarly, in fauna, out of 81,250 recorded species, 16,214



insect species, 44 mammals, 42 birds, 164 reptiles, 121 amphibians and 435 fish species are endemic.

Primate diversity in India matches countless habitats. Some of the important ones are: tropical rainforests, tropical moist and dry deciduous, wetlands, swamps and mangroves, temperate hill forests, arid scrub-savannah, hot deserts, grasslands, vast plains, sub-alpine and alpine forests, Himalayan foothills, high peaks and cold deserts. A total of 21 species of primates are recorded from 3 families in the sub-continent, including Sri Lanka. In India alone 15 species are found, of which 3 (20%)

are endemic ranking third in primate endemism. These species belong to 3 families: (a) Cercopithecidae (12 species), (b) Hylobatidae (1 species), and (c) Lorisidae (2 species) (Table 2). Two more species (*Rhinopithecus roxellanae* and *Macaca thibetana*) are also reported from Manipur and Assam respectively, though their status is still unconfirmed.

Distribution Pattern of Indian Primates

India falls in the Oriental Region, which has two sub-regions: Indian and Indo-Chinese. Two provinces represent the Indian sub-region, namely, North India with 2 primate

Table 2. List of Indian Primates

Family	Subfamily	Common Name	Scientific Name
Lorisidae	Lorinae	Slender loris	<i>Loris tardigradus</i> (1)
		Slow loris	<i>Nyctibus coucang</i> (2)
Cercopithecidae	Cercopithecinae	Lion-tailed macaque	<i>Macaca silenus</i>
		Pig-tailed macaque	<i>Macaca nemestrina</i>
		Bonnet macaque	<i>Macaca radiata</i>
		Assamese macaque	<i>Macaca assamensis</i>
		Crab-eating macaque	<i>Macaca fascicularis</i>
		Rhesus macaque	<i>Macaca mulatta</i>
		Stump-tailed macaque	<i>Macaca arctoides</i>
	Colobinae	Hanuman langur	<i>Semnopithecus entellus</i>
		Nilgiri langur	<i>Trachypithecus johnii</i> (3)
		Golden langur	<i>Trachypithecus geei</i>
		Phayre's langur	<i>Trachypithecus phayrei</i> (4)
		Capped langur	<i>Trachypithecus pileatus</i>
Hylobatidae		Hoolock gibbon	<i>Bunopithecus hoolock</i> (5)

(1) Two subspecies are identified in India: *Loris lydekkerianus lydekkerianus* (Mysore area) and *L.l.malabaricus* (Malabar coast). *Loris tardigradus* is reported in SW Sri Lanka only.

(2) The new proposed species *N. bengalensis*. *N. coucang* is reported in Sumatra, Peninsular Malaysia, Indonesia, south of Isthmus of Kra.

(3) Genetic evidence refers it to genus *Semnopithecus*, but morphological evidence puts it in the genus *Trachypithecus* (Brandon-Jones 2000).

(4) It has been suggested as a subspecies of *Trachypithecus obscurus* (Brandon-Jones 2000).

(5) Genus changed to *Bunopithecus* with common name as 'Western Hoolock' (Brandon-Jones 2000).



Table 3. Distribution Pattern of Indian Primates

Region	Sub-Region	Province	Number of species	Common Name
Oriental	Indian	North India	2	Rhesus macaque
				Common langur
		South India	5	Slender loris
				Bonnet macaque
				Lion-tailed macaque
				Crab-eating macaque
				Nilgiri langur
	Indo-Chinese	Assam/Burma	8	Phayre's langur
				Capped langur
				Golden langur
				Pig-tailed macaque
				Stump-tailed macaque
				Assamese macaque
				Hoolock gibbon
				Slow loris

species and South India with 5 primate species. The Indo-Chinese sub-region has one province (Assam–Burma) and is the richest area with respect to primate diversity with 8 confirmed species (Table 3) (Centre spread).

Biogeographic Zones and Primate Distribution in India

Based on the large distinctive units of similar ecology, biome representation, community and species, 10 different biogeographic zones are identified in India (Rodgers *et al.*, 2002). One or more primate species represent each of these zones (Table 4). Northeast India is the richest in terms of primate diversity with 10 species, followed by the Deccan Peninsula (6 species) and the Western Ghats (5 species). It may be worthwhile to highlight that both the northeast and Western Ghat zones, area-wise

are 2 of the smallest zones compared to the other zones (except the Coasts and the Islands zones).

Distribution of Primate Species in Different Indian States/UTs

Different States and Union Territories (UTs) offer a wide array of habitats for different primate species. Depending largely upon the 'specialist' versus 'generalist' feeding pattern, 'commensal' versus 'non-commensal' behaviour, different primate species occupy varied habitat types. As expected, a 'generalist' feeder species shall have a wider habitat occupancy as compared to a 'specialist' feeder. Similarly, a 'commensal' species may be able to occupy a habitat with human presence and heavy biotic disturbance. On the other hand, a 'non-commensal' species shall inhabit areas with little or no human

Table 4. Distribution of Primate Species in Biogeographic Zones of India

Zone No.	Zone	Area (km ²)	Percentage of India	No. of PAs	Area (Percentage of zone)	Primates Species	
						No.	Name
01	Trans Himalayas	1,84,823	5.62	7	9.2	1	HL*
02	The Himalayas	2,10,662	6.41	68	9.72	4	HL, RM, PTM, AM
03	The Indian Desert	2,15,757	6.56	6	7.51	2	HL, RM
04	The Semi-Arid	5,45,850	16.6	88	2.84	2	HL, RM
05	The Western Ghats	1,32,606	4.03	56	10.11	5	HL, BM, LTM, NL, SL
06	The Deccan P'sula	13,80,380	41.9	141	3.76	6	HL, RM, BM, LTM, NL, SL
07	The Gangetic Plains	3,54,782	10.8	38	2.2	2	HL, RM
08	The Coasts	82,813	2.52	26	6.16	4	HL, RM, BM, AM
09	Northeast India	1,71,341	5.21	43	3.17	10	HL, RM, PTM, AM, STM, CL, PL, GL, HG, SLL
10	The Islands	8,249	0.25	105	18.57	2	RM, CEM

*Up to 3600 m HL—Hanuman langur; RM—Rhesus macaque; PTM—Pig-tailed macaque; AM—Assamese macaque; BM—Bonnet macaque; LTM—Lion-tailed macaque; NL—Nilgiri langur; SL—Slender loris; STM—Stump-tailed macaque; CL—Capped langur; PL—Phayre's langur; GL—Golden langur; HG—Hoolock gibbon; SLL—Slow loris; CEM—Crab-eating macaque

presence and biotic disturbances. However, other ecological and behaviour traits do interact in deciding upon the effectiveness of a given habitat for a given primate species. Table 5 provides a broad overview on the likelihood of the presence/absence of certain primate species in a given State/UT. This only reflects on the presence and absence of a species, either in part of or in entire habitat areas of the concerned State/UT (details on the distribution of different species have been provided in different articles in this issue).

Primate Diversity in Relation to Forest Types, Forest Cover and Protected Areas in India

Forest Types and Primate Diversity

As discussed earlier, India is endowed with an array of habitats, ranging from coasts to lofty

snow-clad mountains of temperate climate. In between lies the tropical, sub-tropical, deserts, swamps and littoral habitat types. Each of these habitats has a complex association of different forest types, thus, offering additional microhabitats and niches for diverse flora and fauna. Broadly, 15 different forest type formations are identified within the above-mentioned wide array of habitat types. These also include man-made plantations as one distinct forest type.

Primate species follow a pattern in their distribution in different forest types (Table 6).

The differences in presence/absence, abundance/rarity of a given primate species is largely dependent on its feeding ecology ('generalist' versus 'specialist') and behaviour ('arboreal' versus 'terrestrial', 'commensal' versus 'non-commensal'). The more generalist,



Table 5. Primate species in the Indian States/UTs

States/UTs	Area (km ²)	Protected Areas		No.	Primate Species
		No.	% Area of state		Species
Andhra Pradesh	275045	25	4.7	4	HL, RM, BM, SL
Arunachal Pradesh	83743	13	11.82	6 + 1?	RM, PTM, STM, AM, HL (?), HG, CL, SLL
Assam	78438	20	3.64	10	RM, PTM, STM, AM, HL, HG, CL, PL, GL, SLL
Bihar	9463	12	3.49	2	RM, HL
Chhatisgarh	135194	13	4.7	2	RM, HL
Goa	3702	7	20.4	3	RM, BM, HL
Gujarat	196024	25	8.62	2	RM, HL
Haryana	44212	8	1.8	2	RM, HL
Himachal Pradesh	55673	34	12.94	2	RM, HL
Jammu & Kashmir	222236	19	6.69	2	RM, HL
Jharkhand	79714	11	2.63	2	RM, HL
Karnataka	191791	26	3.32	4	BM, HL, NL, SL
Kerala	38863	15	6.9	5	BM, HL, NL, LTM, SL
Madhya Pradesh	308252	34	3.52	2	RM, HL
Maharashtra	307713	40	4.98	2	BM, HL
Manipur	22327	4	1.94	5	RM, AM, PTM, CL, SLL
Meghalaya	22429	5	1.34	6	RM, GL, CL, HG, PTM, SLL
Mizoram	21081	6	4.85	5	RM, CL, HG, PTM, SLL
Nagaland	16579	4	1.34	4	RM, CL, PTM, SLL
Orissa	155707	20	5.12	2	RM, HL
Punjab	50362	10	0.63	2	RM, HL
Rajasthan	342239	28	2.8	2	RM, HL
Sikkim	7096	6	28.88	5	RM, PTM, STM, SLL
Tamil Nadu	130058	24	2.19	5	BM, NL, LTM, HL, SL
Tripura	10486	4	5.76	8	RM, PTM, STM, CL, PL, GL*, HG, SLL
Uttaranchal	53484	12	12.1	2	RM, HL
Uttar Pradesh	241335	24	2.41	2	RM, HL
West Bengal	88752	20	3.27	2	RM, HL
A & N Islands	8249	102	15.43	1	CEM
Chandigarh	114	1	25.42	2	RM, HL
Dadra & Nagar Haveli	491	1	18.77	1	BM
Lakshadweep	32	0	0	1	BM
Pondicherry	492	0	0	2	BM, HL
Daman & Diu	112	1	1.95	2	BM, HL
Delhi	1483	1	0.89	2	RM, HL

HL—Hanuman langur; RM—Rhesus macaque; PTM—Pig-tailed macaque; AM—Assamese macaque; BM—Bonnet macaque; LTM—Lion-tailed macaque; NL—Nilgiri langur; SL—Slender loris; STM—Stump-tailed macaque; CL—Capped langur; PL—Phayre's langur; *GL—Golden langur (Introduced from captivity); HG—Hoolock gibbon; SLL—Slow loris; CEM—Crab-eating macaque

Table 6. Forest Types and Primate Species

States/UTs	Forest Types	No. of PAs	Primate Species	
			No.	Species
Andhra Pradesh	TDD, TT, TMD, TDE, LSW	25	4	HL, RM, BM, SL
Arunachal Pradesh	TWE, STP, MWT, SAF	13	6 + 1?	RM, PTM, STM, AM, HL (?), HG, CL, SLL
Assam	TWE, TSE, TMD, STBH, STP, LSW	20	10	RM, PTM, STM, AM, HL, HG, CI, PL, GL, SLL
Bihar	Tmd, Tde, Stbh	12	2	Rm, HI
Chhatisgarh	Tmd, Tde, Stbh	13	2	Rm, HI
Goa	Twe, Tse, Lsw	7	3	Rm, Bm, HI
Gujarat	Tmd, Tdb, Tt, Lsw	25	2	Rm, HI
Haryana	Tdd, Tmd, Tt	8	2	Rm, HI
Himachal Pradesh	Tdd, Stp, Stde, Hmt, Hdt, Saf	34	2	Rm, HI
Jammu & Kashmir	Stde, Hmt, Hdt, Stp, Saf	19	2	Rm, HI
Jharkhand	Tmd, Tdd, Tt, Stbh	11	2	Rm, HI
Karnataka	Twe, Tse, Tmd, Tdd, Tt	26	4	Bm, HI, NI, SI
Kerala	Twe, Tse, Tmd, Tdd, Stbh, Mwt, Lsw	15	5	Bm, HI, NI, Ltm, SI
Madhya Pradesh	Tmd, Tdd, Tt, Stbh	34	2	Rm, HI
Maharashtra	Tse, Tmd, Tdd, Tt, Stbh, Lsw	40	2	Bm, HI, Rm
Manipur	Tse, Stp, Mwt	4	5	Rm, Am, Ptm, CI, SII
Meghalaya	Stp, Twe, Tse, Tmd	5	6	Rm, GI, CI, HG, Ptm, SII
Mizoram	Twe, Tmd, Stp	6	5	Rm, CI, HG, Ptm, SII
Nagaland	Twe, Tmd, Mwt, Stp	4	4	Rm, CI, Ptm, SII
Orissa	Tse, Tmd, Tdd, Lsw	20	2	Rm, HI
Punjab	Tdd, Stde, Tt	10	2	Rm, HI
Rajasthan	Tdd, Tt	28	2	Rm, HI
Sikkim	Tmd, Hmt, Hdt	6	5	Rm, Ptm, STM, HI, SII
Tamil Nadu	Twe, Tse, Tmd, Tdd, Tt, Mwt, Stbh, Lsw	24	5	Bm, NI, Ltm, HI, SI
Tripura	Tmd, Stbh	4	8	Rm, Ptm, STM, CI, PI, GI*, HG, SII
Uttaranchal	Tmd, Std, Hmt, Hdt, Saf	12	2	Rm, HI
Uttar Pradesh	Tmd, tdd, Tt	24	2	Rm, HI
West Bengal	Tse, Tmd, Tdd, Stbh, Stp, Hmt, Mt, Lsw			
A & N islands	Twe, Tse, Tmd, Lsw	102	1	Cem
Chandigarh	Tdd	1	2	Rm, HI
Dadra & Nagar Haveli	Tmd	1	1	Bm
Lakshadweep	PI	0	1	Bm
Pondicherry	PI	0	2	Bm, HI
Daman & Diu	PI	1	2	Bm, HI
Delhi	Tdd	1	2	Rm, HI

TDD—Tropical dry deciduous, TT—Tropical thorn, TMD—Tropical moist deciduous, TDE—Tropical dry evergreen, LSW—Littoral & Swamp. TWE—Tropical wet evergreen, STP—Sub-tropical pine, MWT—Montane wet temperate, SAF—Sub-alpine forest, TSE—Tropical semi-evergreen, STBH—Sub-tropical broadleaved hill. STDE—Sub tropical dry evergreen, HMT—Himalayan moist temperate, HDT—Himalayan dry temperate, PL—Plantations

HL—Hanuman langur; RM—Rhesus macaque; PTM—Pig-tailed macaque; AM—Assamese macaque; BM—Bonnet macaque; LTM—Lion-tailed macaque; NL—Nilgiri langur; SL—Slender loris; STM—Stump-tailed macaque; CL—Capped langur; PL—phayre's langur; GL—Golden langur; HG—Hoolock gibbon; SLL—slow loris; CEM—Crab-eating macaque.



terrestrial, and commensal species inhabit States/UTs mostly rich is Tropical thorn (TT), Tropical dry evergreen (TDE), Sub-tropical broad-leaved hill (STBH), Sub-tropical dry evergreen (STDE), and Tropical dry deciduous (TDD) forest types. The 3 ubiquitous primate species falling in this category are Hanuman langur in association with the Rhesus macaque in 18 States/ UTs, in association with the Bonnet macaque in 9 States/ UTs. Specialist feeders, arboreal, and non-commensal primates are restricted in their distribution to primary, dense tropical wet/evergreen/semi-evergreen forests for meeting their ecological and behavioural needs. The examples are: Hoolock gibbon, Slow loris, Slender loris, Pig-tailed macaque, Stump-tailed macaque, Phayre's langur, Capped langur, Golden langur, and Assamese macaque. These are present in association of 4 or more species in a given State/UT. Only 12 States/UTs have 4 or more primate species, while the rest of the States/UTs have primate species ranging from 1 to 3 in their diversity. All the 12 States/UTs with 4 or more primate species have either of the 3 forest types, namely, Tropical wet evergreen (TWE), Tropical moist deciduous (TMD), and Tropical semi-evergreen (TSE) forests,

either independently or in different associations.

TWE, TMD, and TSE forest types are present in 23 States/UTs in different combinations. All States/UTs with TWE forest type alone or in association with either TMD and/or TSE (besides other forest types contributing insignificantly) have 4 or more primate species (Table 7).

Of the 15 different forest types in India, TDD forests cover the maximum forest area in the country (38.2% of total forest area). TMD, TT, TWE, and Sub-Tropical Pine (STP) make up for 30.3%, 6.7%, 5.8%, and 5.0%, respectively. The remaining forest types make up for 14% of the total forest areas of the country. States and UTs with TWE as one of the major forest types have the highest primate diversity with species number going up to 10 (Assam). Similarly, States and UTs with either TMD or TSE forest type are also rich in primate diversity as the number of primate species reaches up to 6 (Arunachal Pradesh, Meghalaya) and 8 (Tripura). The majority of the forest types (11 different types) of the Trans-Himalayas, Indian Desert, Semi-Arid, Gangetic Plains, and the Islands' bio-geographic regions, support only 1–3 primate species (mainly Rhesus macaque,

Table 7. Number of States/UTs and Primate Species in 3 different Forest Types

States with Forest Types		Number of Primate Species in States/UTs (for names refer Table 5)
Forest Types	Number of States/UTs	
TWE	1	7
TMD	9	4, 2, 2, 2, 2, 5, 8, 2, 1
TSE	1	5
TWE + TMD	4	10, 4, 5, 4
TMD + TSE	3	2, 2, 2
TWE + TSE	2	6, 3
TWE + TMD + TSE	3	5, 5, 1

TWE—Tropical Wet Evergreen, TMD—Tropical Moist Deciduous, TSE—Tropical Semi-Evergreen

Table 8. Forest type, and primate diversity in the different states and UTs in India

Forest Type	% of Forest Area	No. of States/UTs	Range of primate diversity
Tropical Wet Evergreen	5.8	10	2–10
Tropical Semi-Evergreen	2.5	9	1–6
Tropical Moist Deciduous	30.3	19	1–8
Littoral and Swamp Forest	0.9	10	1–2
Tropical Dry Deciduous	38.2	14	1–2
Tropical Thorn	6.7	11	1–2
Tropical Dry Evergreen	0.1	3	1–2
Sub-Tropical broadleaved Hill	0.4	10	2–3
Sub-Tropical Pine	5.0	9	2–3
Sub-Tropical Dry Evergreen	0.2	2	2–3
Montane Wet Evergreen	2.0	6	2–3
Himalayan Moist Temperate	3.4	5	2–3
Himalayan Dry Temperate	0.2	4	1–5
Sub-Alpine and Alpine Forest	4.3	4	1–2

Hanuman langur, and Bonnet macaque) (Table 8).

TMD as one main forest type is present in 9 States/UTs (Figure 4). In only 3 states (Andhra Pradesh, Sikkim, and Tripura) the number of primate species is 4 or more. But, there is a clear inverse relationship between the number of Protected Areas (PA) and primate species. Tripura with the maximum number of primate species (8) has only 4 PAs (all sanctuaries), while Sikkim with 6 primate species has only 6 PAs. Andhra Pradesh with 4 primate species has 25 PAs, but these cover only 4.7% of the total geographical area of the state, although, the state has almost 16% of the geographical area under forest cover. The remaining 6 States/UTs with relatively higher number of PAs has only 1–2 primate species. This suggests that there exists lots of scope to bring in more dense forest areas under the Protected Area

coverage in rich primate diversity States/UTs.

Only 4 states (Assam, Karnataka, Mizoram, and Nagaland) have TSE and TMD as the main forest types. These states are rich in primate diversity with 4 and more species (Figure 5). Although, Assam and Karnataka are well represented in the number of PAs (20 and 26 respectively) as compared to Mizoram (5) and Nagaland (4), yet, in terms of percentage of geographical area under forest cover, all 4 states are far below the required percentage. However, with a high percentage of dense forest cover in all these states, more area can be brought under the PA network.

Forest Cover, Protected Area Network, and Primate Diversity

The main strategy for conserving the unique biodiversity in India (including primate diversity) has been through the protection of viable



Figure 4. Status of Primate Species, Protected Areas and Dense Forest Cover in States/UTs with Tropical Moist Deciduous Forest Type

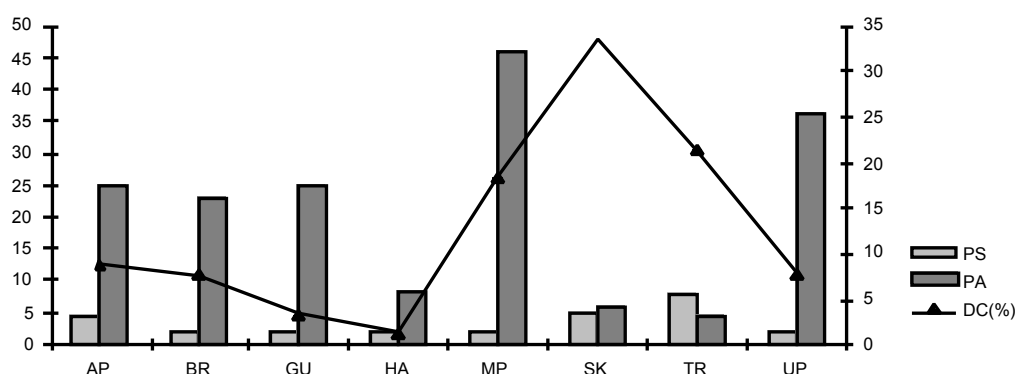
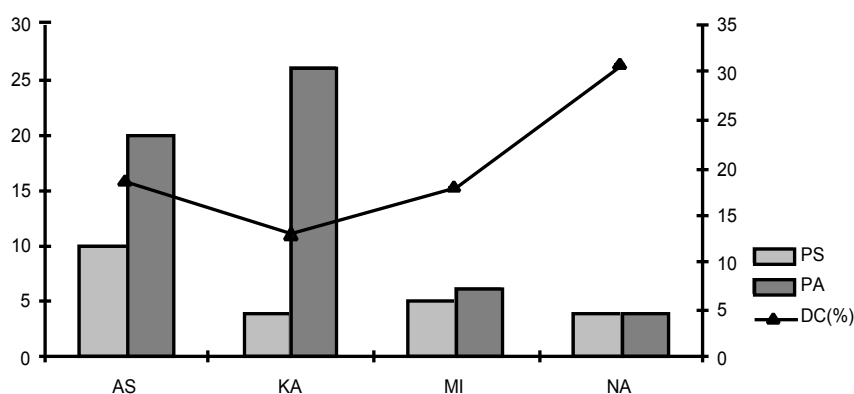


Figure 5. Status of Primate Species, Protected Areas, and Dense Forest Cover in States/UTs with Tropical Wet Evergreen and Moist Deciduous Forest Types



areas of habitats and ecosystems, mainly by the creation and development of the PA network of National Parks, Sanctuaries, Biosphere Reserves, and identified wetlands and coastal areas. In addition, special projects have been undertaken for the protection of threatened species: Project Tiger, Project Elephant, Gir Lion, Crocodiles, Swamp Deer, Brow Antlered Deer, Snow Leopard, Kashmir Stag, and Himalayan Musk Deer.

Currently, there are 89 National Parks covering an area of 37496.72 km² and 489 Sanctuaries over 1,17,076.08 km² of prime forests and wildlife-rich areas. The area under the PA

system has increased from 109,652 km² (3.4%) in 1988 to 154,572.8 km² (4.7%) in 2002 (Rodgers *et al.*, 2002). However, conservationists still feel that many key species of flora and fauna, ecosystems, communities, and values are either poorly represented or not represented at all. A national review of the existing PA network systems completed in the year 2000 by the Wildlife Institute of India recommends a network of 858 PAs covering an area of 1,87,192 km² (about 5.6% of the country's geographical area).

Table 9 provides an overview of the status of area under forest cover, dense forest cover,

Table 9. Number of Primate Species Vs Percentage Forest Cover, Dense Forests and Protected Areas of the Total Geographical Area of Different States and Union Territories

States/UTs	Percentage of Geographical Area of States/UTs			No. of Primate Species
	Forest Cover	Dense Forest	PAs	
Andhra Pradesh	16.1	8.8	4.7	4
Arunachal Pradesh	82.2	68.9	11.82	6 + 1?
Assam	30.2	18.5	3.64	10
Bihar + Jharkhand	15.2	7.6	6.12	2
Goa	33.8	26.8	20.4	3
Gujarat	6.6	3.3	8.62	2
Haryana	2.2	1.0	1.8	2
Himachal Pradesh	23.5	16.4	12.94	2
Jammu & Kashmir	9.2	4.9	6.69	2
Karnataka	16.9	12.9	3.32	4
Kerala	26.6	21.7	6.9	5
Madhya Pradesh + Chhattisgarh	29.7	18.4	8.22	2
Maharashtra	15.2	8.6	4.98	2
Manipur	77.9	26.6	1.94	5
Meghalaya	69.7	26.4	1.34	6
Mizoram	86.9	17.9	4.85	5
Nagaland	85.4	30.9	1.34	4
Orissa	30.2	16.7	5.12	2
Punjab	2.8	1.0	0.63	2
Rajasthan	4.1	1.3	2.8	2
Sikkim	43.9	33.3	28.88	5
Tamil Nadu	13.1	6.7	2.19	5
Tripura	54.8	21.2	5.76	8
Uttar Pradesh + Uttaranchal	11.6	7.8	14.52	2
West Bengal	9.4	4.0	3.27	2
A & N Islands	92.2	78.9	15.43	1
Chandigarh	6.1	5.3	25.42	2
Dadra & Nagar Haveli	41.1	32.4	18.77	1
Lakshadweep	0.0	—	0	1
Pondicherry	0.0	—	0	2
Daman & Diu	2.7	—	1.95	2
Delhi	5.9	2.4	0.89	2

protected area network, and primate diversity in each State and UT of India. There is hardly any correspondence between the percentage under cover forests, dense forest cover, percent area under protected areas, and primate diversity.

In most of the States and UTs (19), the PA is below the desired percentage 6% (Figure 6), but with maximum primate diversity (in some States/UTs even 5–10 primate species are present). However, these States and UTs have vast areas under forest cover, the majority of which is dense forest cover (Table 9). Therefore, there is scope for adding further to both—the number and area of the existing PAs. Another alternative could be to impart better protection measures for wilderness areas in managed forests outside the notified PA network. Both the above steps shall ensure suitable ecological habitat and better protection to some of the highly endangered primate species.

On the other hand, States and UTs with more area under PA systems have poor primate diversity with only 1–3 primate species inhabiting these PAs. This is because of the vegetation types in these PAs consisting mainly of Tropical dry deciduous and Tropical thorn forests. As discussed in the preceding



Figure 6. No. of States/UTs with Per cent Area under PAs

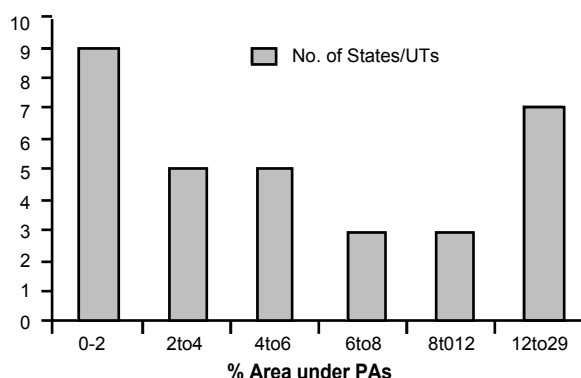
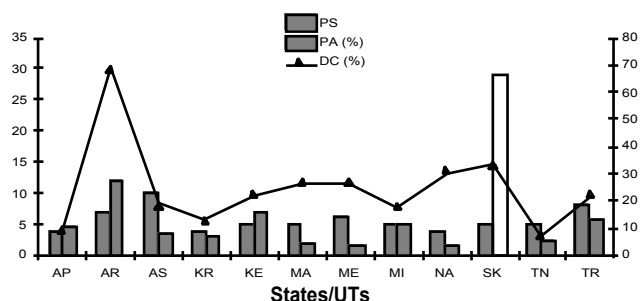


Figure 7. Status of Protected Area Per cent and Dense Forest Cover Per cent States/UTs with 4 or more Primate Species



paragraphs, the most common primate species are the generalist feeders, terrestrial and commensal species, e.g., RM, HL, and BM. Conversely, the area available as forest and dense forest cover in these States and UTs has been comparatively less than that from those States and UTs described in the preceding paragraph with a lesser number of PAs but high primate diversity.

Only 12 States/UTs have 4 or more primate species (Figure 7). Except Arunachal Pradesh and Sikkim with 11.8 and 28.9 per cent of the total geographical area under the PA network, in the remaining 10 States and UTs, it ranges between 1.3% (Meghalaya and Nagaland with 6 and 4 primate species, respectively) and 6.9 per cent (Kerala, 5 primate species). Except Sikkim, the remaining 11 States/UTs are part of two 'hot-spots' of the country. All the 7 northeastern states make up the

northeastern Himalayas 'hot-spot', while Andhra Pradesh, Karnataka, Kerala, and Tamil Nadu together constitute part of the 'Western Ghats' hot-spot. The northeastern states exhibit the highest primate diversity (10 species), but only 5.5% of the total geographical area of the northeast is under protected area network. Similarly, the Western Ghats, though poorer in primate diversity (5 species) than the northeastern region, is represented by some of the highly endangered endemic primate species (Lion-tailed macaque, Nilgiri langur, and Slender loris). The area under the PA network is still lower at only 4.4% of the total geographical area of the 4 states. All this in spite of the fact that both these hot-spot

areas are endowed with the richest and most dense tropical wet and semi-evergreen forest types.

The area under dense forest cover in all these states (except Sikkim) is almost 3–6 times the area currently under the PA network. This suggests that there is lots of scope for consolidating not only the existing fragmented PA but also for creating new ones covering habitats of rare and endangered primate species.

Primate Diversity in Tribal and Hill Areas

The presence of a high percentage of forest cover in tribal and hill areas directly corresponds with the presence of either of the TWE, TSE, and TMD forest types and a high primate diversity. The relationship between per cent forest cover in the tribal and hill areas and primate diversity is much more close and direct than between per cent total forest cover

and primate diversity, and/or between forest types/number of PAs and primate diversity. The greater the per cent forest cover in the tribal and hill areas, the greater is the primate diversity (provided the forest type is at least one of the following 3 types: TWE, TSE, and TMD). This also entails that primate rich areas are also generally the tribal dominated areas.

Distribution Range and Conservation Status of Primates (Indian Species)

Distribution Range

Indian primates exhibit two definite extremes in their distribution range. Few species are highly endemic and at a very low population level surviving a narrow distribution range (Lion-tailed macaque, Nilgiri langur, Golden langur, Crab-eating macaque, Hoolock gibbon). On the other hand, there are species that enjoy a wider distribution range spread over other neighbouring South and Southeast Asian countries (Hanuman langur, Rhesus macaque, Bonnet macaque, Pig-tailed macaque).

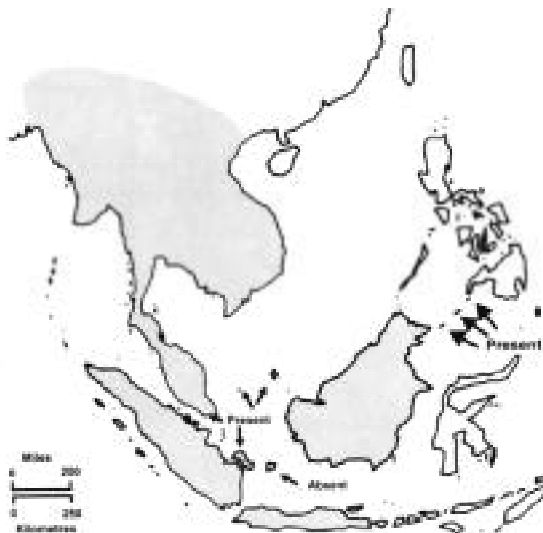
The distribution status of different Indian primate species has been dealt with in sufficient details in various chapters on 'Status Reports' and 'Species Profile' in this issue. Therefore, I am only providing the graphic representation of the distribution of different Indian primate species, and highlighting their presence/absence specifically in/from South and Southeast Asian countries.

Loris

The members of the family Lorisidae are confined to Africa, and South and Southeast Asia. Of the total 5 species, 3 (*Arctocebus*, *Galago*, and *Perodicticus*) are in Africa. The other 2 are found in Southeast Asia; *Loris* in Ceylon and southern India (north of Tapti river

up to about 1850 m); and *Nycticebus* (2 species), found in South and Southeast Asia: northeastern India, Bangladesh, Myanmar, Malaya and adjacent islands including Singapore, Thailand, Laos, Cambodia, Vietnam, Indonesia (Sumatra, Java, Borneo, and some adjacent islands), probably in the Philippines up to about 1100 m.

Brandon-Jones (2001) recognizes 2 species in genus *Loris*, namely, *lydekkerianus* (4 subspecies) found in India and Sri Lanka, and *tardigradus* (subspecies) found in Sri Lanka. Genus *Nycticebus* has 3 species, namely, *bengalensis* (Myanmar, Cambodia, South China, Northeast India, Laos, Thailand, Vietnam); *coucang* (3 subspecies) found in Java,



Malayasia, Sumatra, Brunei, etc., and *Pygmaeus* (2 subspecies) present in Cambodia, South China, Laos, and Vietnam.

Macaca

Macaques are the Asian members of the cercopithecinae sub-family of Old World monkeys. The only non-Asian species is the Barbary 'ape' of North Africa and Gibraltar. Genus *Macaca* occupies a geographical range



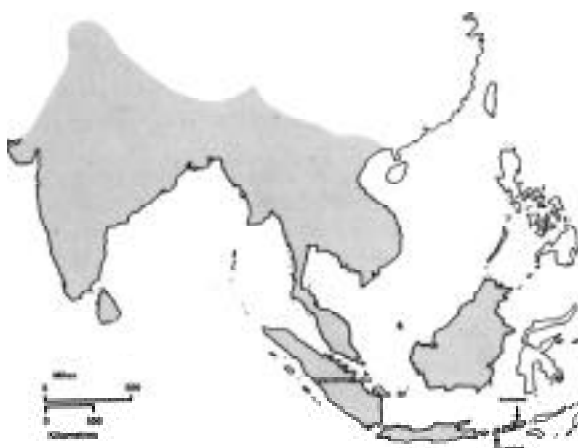
second in size only to that of *Homo*. In Asia the range extends from Afganistan to Japan, reaching at times as far north as 35–40°. Southward, it encompasses the Indian Subcontinent and Sri Lanka, and much of Southeast Asia, including the Malay Archipelago and major islands of Indonesia as far east as Timor and Sulawesi, and the Philippines. The genus has achieved outstanding evolutionary success in its occupation of habitat types; from near desert to obligate rain forest habitation, from sea level to snow-clad areas at 3000 m, from wild 'non-commensal' dwellings to urban dwellings 'commensal' with humans.

Fooden (1976) divided the genus into 4 species-groups, based mainly on the shape of the male genitalia: *sylvanus-silenus* group; *fascicularis* group; *sinica* group; and *arctoides* group. Groves (2001) has divided the genus into 6 groups:

- *M. sylvanus* groups
- *M. nemestrina* group: *M. nemestrina*, *leonina*, *silenus*, *pagensis*
- *Sulawesi* group
- *M. fascicularis* group: *M. fascicularis*, *arctoides*
- *M. mulatta* group: *M. mulatta*, *cyclopis*, *fuscata*
- *M. sinica* group: *M. sinica*, *radiata*, *assamensis*, *thibetana*

Langur Group (adapted from Groves, 2001)

Semnopithecus or *Presbytis* was the only genus for the langur group of primates till recently, Pocock (1928) gave 3 groups: *Entellus*, *Pyrrhus*, and *Aygula* based on the colour of the neonates—black, golden red, and cruciger respectively. These 3 groups were later

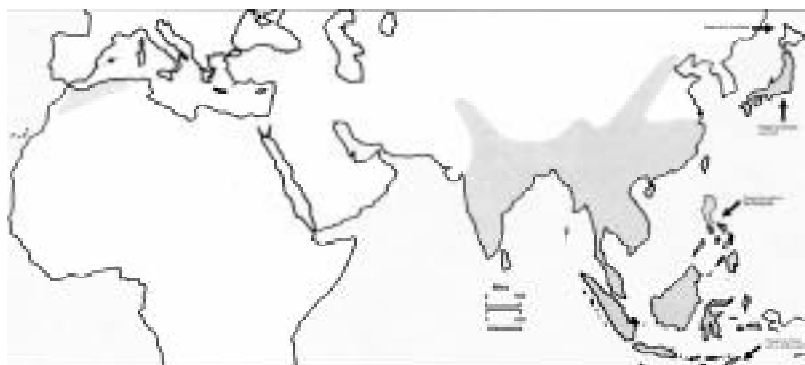


recognized as genera by Pocock (1935), namely, *Semnopithecus*, *Trachypithecus*, and *Presbytis*. Hill (1934) recognized a fourth group—Kasi. Weitzel and Groves (1985) and Groves (1989) placed all Asian langur species into 3 genera: *Semnopithecus*, *Presbytis*, and *Trachypithecus*.

Hylobatidae

This family includes the lesser apes (gibbons and siamangs) of South and Southeast Asia (Eastern Assam to Borneo).

Earlier this family included 2 genera: *Hylobates* (gibbons) and *Symphalangus* (siamangs), of which only *Hylobates* (with 2 subspecies: *H.*



hoolock and *H. lar*) is found in South Asia. Brandon-Jones (2001) has recognized four genera:

- *Bunopithecus* (one species *hoolock* and 2 subspecies, *hoolock* of Bangladesh, India, Myanmar; and *leuconedys* of Myanmar and South China).
- *Hylobates*: 5 species, namely, *agilis* with 3 subspecies of Kalimantan, Indonesia, Peninsular Malaysia; *klossii* of Mentawai islands; *lar* with 5 subspecies of Myanmar, Sumatra, Yunnan; *moloch* with 2 subspecies of Java; and *Muelleri* with 4 subspecies of Brunei, Kalimantan, Sarawak.
- *Nomascus*: 3 species, namely, *concolor* of

Yunnan, Vietnam; *leucogenys* of Yunnan, Laos and Vietnam; and *gabriellae* of Cambodia, Laos and Vietnam.

- *Symphalangus*: 1 species *syndactylus* of Sumatra and Peninsular Malaysia with 2 subspecies.

Conservation Status

Of the 15 primate species, 9 are 'scheduled species' as these are included in the Schedule I (1) of the Wildlife (Protection) Act, 1972 as amended in 1991 (Table 10). The remaining 6 species are 'non-scheduled' species as these are included in Part II of Schedule II of the said Act. The 'scheduled species' enjoys

Table 10. Conservation Status of Indian Primates

Species	General status	WL (P) A	CITES	IUCN
<i>Semnopithecus entellus</i>	Common, but declining	Sch II (1)	I	LR1c/N
<i>Trachypithecus johnii</i>	Limited to South India	Sch I(1)	II	VU A 1 (d)
<i>Trachypithecus geei</i>	Rare, endangered	Sch I (1)	I	CR/N A 1 acd C2a
<i>Trachypithecus phayrei</i>	Rare, limited distribution	Sch I (1)	II	EN C 2a
<i>Trachypithecus pileatus</i>	do	Sch I (1)	II	EN A 1 cd, C 2a
<i>Macaca mulatta</i>	Common in North India	Sch II (1)	II	LR 2 (n/t)
<i>Macaca radiata</i>	Common in South India	Sch II (1)	II	LR 3 (lc)
<i>Macaca arctoides</i>	Rare, endangered	Sch II (1)	II	LR nt/N
<i>Macaca assamensis</i>	Unknown	Sch II (1)	II	LR nt/N
<i>Macaca nemestrina</i>	Rare, endangered	Sch II (1)	II	VU A 1 (c) (d)
<i>Macaca fascicularis</i>	do	Sch I (1)	I	CR/N
<i>Macaca silenus</i>	do	Sch I (1)	I	B 12c C 2 (a)
<i>Bunopithecus hoolock</i>	do	Sch I (1)	I	EN A 1 cd
<i>Loris tardigradus</i>	do	Sch I (1)	II	Lrnt/N
<i>Nycticebus coucang</i>	do	Sch I (1)	II	DD

Modified from Southwick and Lindburg (1986)

WL (P)A = Wildlife (Protection) Act, 1972/Amendment 1991

CITES rating: I = Appendix I (rare and endangered). II = Appendix II (threatened and vulnerable).

For details on the IUCN categories refer to page 67 (box) this issue.



more legal protection from hunting, poaching, and trade as compared to the 'non-scheduled' species. However, going by the present status of the habitat and low population size, the status of at least 3 macaque species (Stump-tailed, Pig-tailed, and Assamese macaques) should be raised from 'non-scheduled' species to 'scheduled' species.

Of the 15 species, 6 are in Appendix I of the CITES (Convention on International Trade in Endangered Species of Wild Fauna and Flora) and the remaining 9 in Appendix II. CITES aims at banning commercial trade in an agreed list of currently endangered species and by regulating and monitoring trade in others that might become endangered. Appendix I includes those species which are threatened with extinction or may be affected by trade. Even species which are widespread and common but are look-alikes and could be confused with a threatened species so as not to endanger them further, are included in Appendix I. Appendix II intends to regulate international trade in species which are not sufficiently endangered to warrant their inclusion in Appendix I, but which could become endangered if trade in them is not controlled. International trade in them is permitted with proper documentation issued by the Government of the exporting country.

Of the 9 primate species belonging to Schedule I(1) of WLPA, 4 are kept in Appendix II of the CITES (Nilgiri langur, Phayre's langur, Slow, and Slender loris), thereby making international trade permissible. This might create an anomaly insofar as trade is considered. By virtue of being Schedule I (1) species of WL (P) A, trade, hunting, and poaching of these species are prohibited, but Appendix II of CITES, permits international trade in a controlled and regulated way, that might lead to clandestine trade of

these species. Moreover, all these species are highly endangered with low population status. It is recommended that the status of these 4 species be upgraded by placing them in Appendix I from Appendix II of the CITES. Similarly, for the 3 macaque species (Assamese, Pig-tailed, and Stump-tailed) that are recommended for inclusion in Schedule (I) of the WL (P) A, their status under CITES should also be upgraded to Appendix I to make their conservation status compatible with WLPA.

Primate Conservation Issues in India

Primate distribution range coincides with the tropical habitat of mostly over-populated (human population) developing countries whose economy is largely dependent on extraction of natural resources. The presence of dense tropical forests is the main natural resource that has been exploited to meet the needs of a vibrant economy. These are also areas inhabited by poor tribal populations who are dependent on forestry resources for sustenance. To top it all is the pressure from the consumer countries of forestry resources on these producer countries. All these factors exert tremendous pressure leading to over-exploitation of forestry resources, which form the main component of habitat for primate species.

Conservation threats to primates could be put broadly into the following categories:

Direct: Direct conservation threats entail reduction in the number of individuals due to poaching, trade in live and dead primates, killing and hunting for food, as pests, for pets, and other economic uses.

Indirect: Indirect conservation threats are associated with the loss and degradation of habitat. The main reasons for the loss of habitat



are deforestation, encroachment, grazing, illicit felling for firewood, fodder and timber, shifting cultivation, agriculture, diversion of forest land for non-forestry and agricultural activities, forest fires.

Future Primate Conservation Recommendations

As discussed above, since the major primate habitats are closely and intricately shared by the local human populations for their sustenance and needs, therefore, any conservation initiative towards primate conservation needs to incorporate human socio-economic concerns. The second most important step towards primate conservation should be the protection of major primate habitats both inside the existing PA network and outside in the managed forests. Fragmentation of habitat, either due to the shifting cultivation and encroachment for non-forestry uses (mainly in the north-east India) and/or proliferation of tea and coffee estates (largely in the Western Ghats, but also in north-east India) needs be arrested. Existing fragmented habitats need be linked with viable and vibrant (also to meet the needs of the local people) corridors.

There is hardly any primate species in India on which complete documentation on its status, ecology, behaviour, and conservation issues are available. The 2 most studied commensal species (Rhesus macaque and Hanuman langur) face new conservation threats following their involvement in severe, complex, and ever-increasing man-monkey conflicts. Even these 2 species hardly have any systematic scientific studies conducted on them addressing the issues of man-monkey conflict. Species-specific and area-specific conservation recommendations are dealt with in detail in the different articles in this bulletin. However,

a few recommendations for primate conservation are listed below:

1. Status surveys.
2. Studies on the Ecology and Behaviour in different habitats, which would form the basis for upgrading the current status of primates from non-scheduled to 'schedule' species as per the Wildlife (P) Act, 1972.
3. Public education and awareness Programmes on the importance of Primates.
4. Eco-development and Joint Forest Management Programmes in and outside PAs to reduce biotic pressure on key primate habitats.
5. Re-evaluation of existing PAs *vis-à-vis* primate habitats and distribution range of primates in India. Accordingly, steps need be taken to make the PA boundaries ecologically compatible with primate needs.
6. Necessary guidelines needs be incorporated in the working plan for territorial forest divisions rich in primate habitat and populations to ensure compatibility between forestry related activities and primate conservation concerns in those areas. It is a proven fact that more concerted efforts are required towards wildlife conservation in areas outside the current PA network.
7. Complete ban on all activities leading to habitat degradation and the resulting loss of available or potential primate habitats.
8. Control on poaching and trade.
9. Identification, documentation, and implementation of various indigenous knowledge based control and mitigation measures addressing primate conservation related issues (e.g., shifting cultivation and killing for local medicinal usage) including human–non-human primate interphase.



10. Recognizing the importance of primates in overall conservation of biodiversity, especially in two 'hot spots' in India, the Government may take up steps to launch 'Project Primate' on the lines of 'Project Tiger' and 'Project Elephant'.

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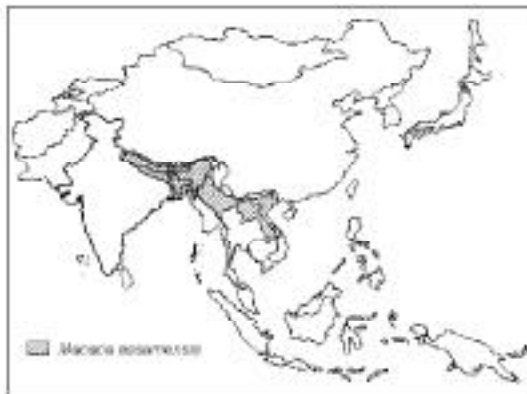


Fig. 12

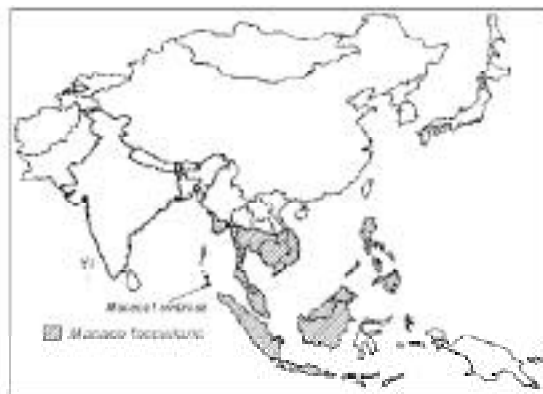


Fig. 13

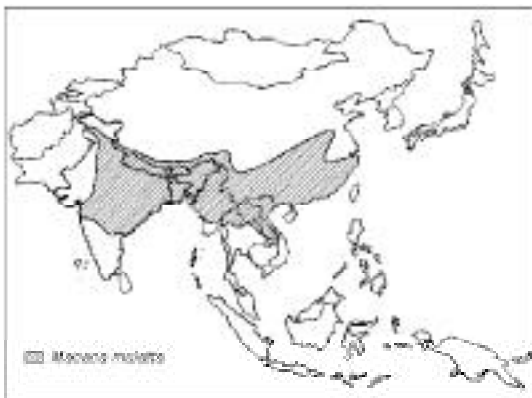


Fig.14

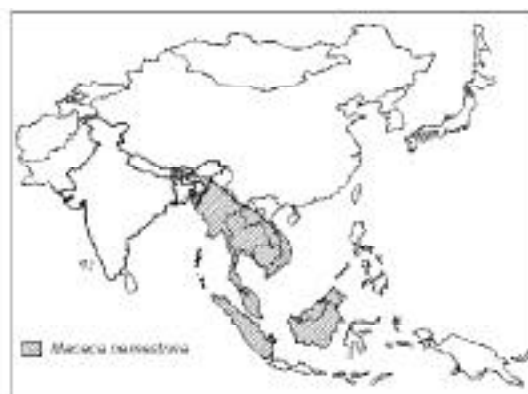


Fig.15



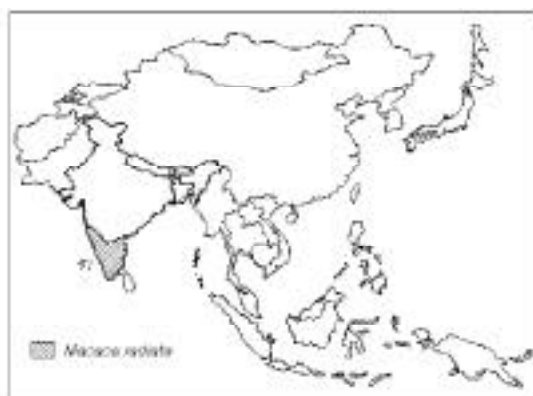


Fig.16

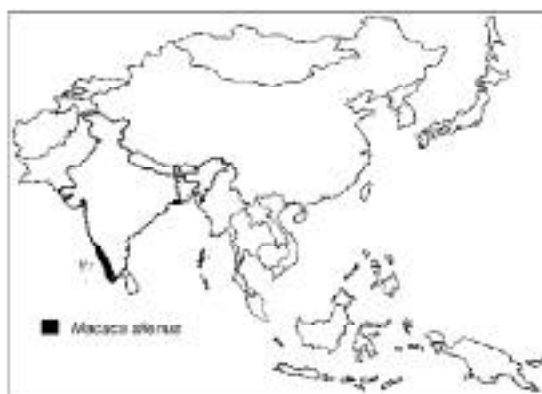


Fig.17

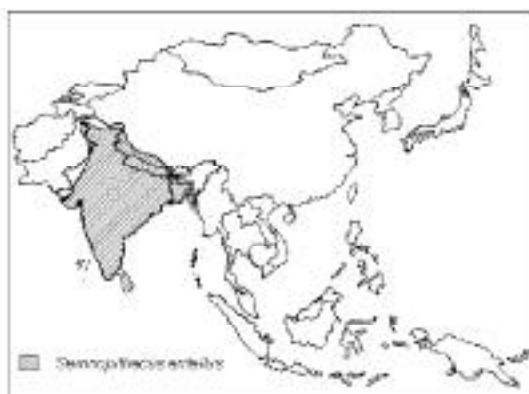


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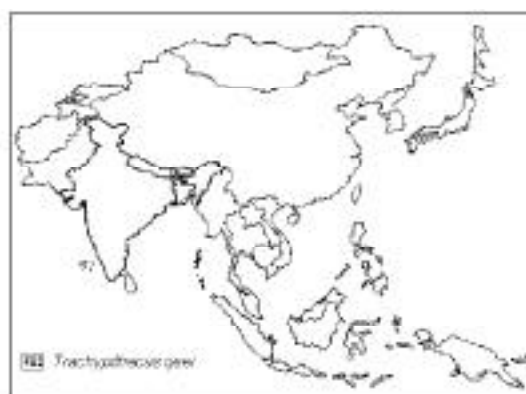


Fig.19



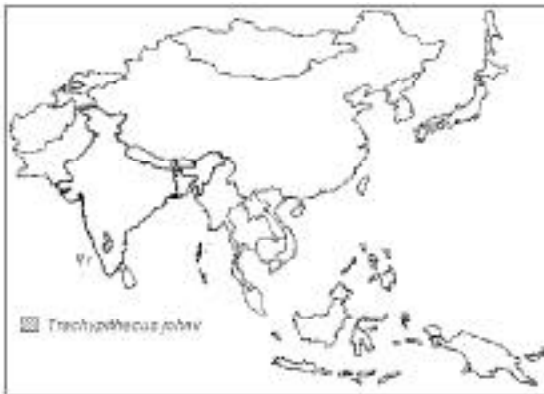


Fig.20

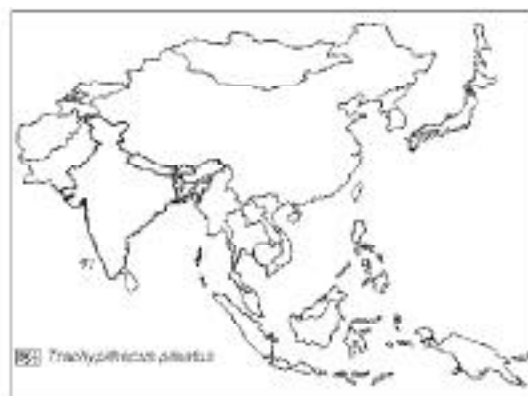


Fig.21

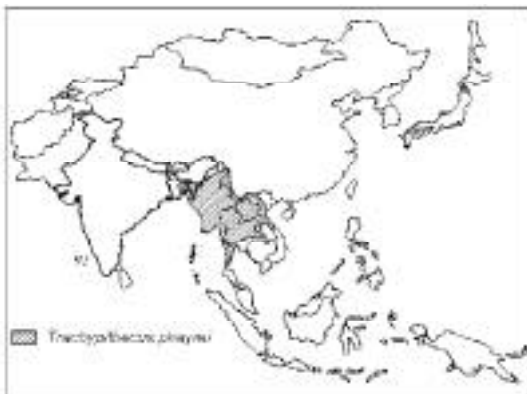


Fig.22



Fig.23



The Bonnet Macaque Revisited: Ecology, Demography and Behaviour

Anindya Sinha



Introduction

This paper briefly reviews certain aspects of the ecology and behaviour of wild Bonnet macaques 'the common performing monkey of South India'. Rather limited in its scope, it does not claim to be exhaustive by any means but only highlights certain problems and questions that I personally consider interesting and important. For more detailed reviews, the reader is directed to Roonwal & Mohnot (1977) and Fooden (1986).

Distribution and Subspecies

Five primate species are found in southern India: Hanuman langur (*Semnopithecus entellus*), Nilgiri langur (*Trachypithecus johnii*), Lion-tailed macaque (*Macaca silenus*), Bonnet macaque (*M. radiata*) and Slender loris (*Loris tardigradus*). Of these, the Bonnet macaque is the most common, extensively distributed from the wet montane rainforests of the Western Ghats through the dry scrublands of central southern India to most of the hot, dusty temple towns and cities of the Peninsula (Krishnan, 1972). The northward distribution of the Bonnet macaque seems to be limited by an imaginary line running from the north of the Velikonda Range of the Eastern Ghats in the east through the Manjra Plateau to the northern end of the

Abstract

Although the Bonnet macaque (*Macaca radiata*), a cercopithecine primate endemic to peninsular India, is widely distributed across a range of ecological environments, much of its ecology, demography and behaviour still remain unknown. The species appears to be unique amongst all macaques in displaying large multi-male troops with balanced sex ratios, an unusually low degree of sexual dimorphism, occasional failure of natal males to emigrate, intense affiliative relationships between males, and extensive ecological and demographic diversity across ecological habitats. The Bonnet macaque is, however, now facing increasing threat with ever-growing human populations, and it has become imperative that strategies be developed to minimize such conflicts and ensure the long-term survival of the species, so ubiquitous all over southern India in earlier times but now severely threatened everywhere.

Western Ghats in the west, its further spread constrained by the equally ubiquitous, but much more geographically successful, Rhesus macaque (*M. mulatta*) of northern India (Fooden *et al.*, 1981; Koyama & Shekar, 1981). Within southern India, however, Bonnet macaques are often found in close association with the Lion-tailed macaque, the Hanuman langur and

the Nilgiri langur in their respective ecological habitats (Singh *et al.*, 1997).

Two subspecies of Bonnet macaques have been morphologically distinguished: the northern, more common, *M. radiata*, and the southern *M. radiata diluta* (Figure 1), believed to be restricted to the southernmost districts of Kerala and Tamil Nadu (Pocock, 1939; Fooden, 1981). The latter, on an average, is smaller in size and has a coat colour that appears to be much paler. The characteristic whorl of hairs on the crown of the head, from which the species gets its name, also seems much longer and yellowish in this subspecies (Pocock, 1939; Sinha, *personal observations*). The legitimacy of these 2 subspecies must, however, remain an open question since there have been no studies which have examined whether they can hybridize with each other, or, for that matter, on any aspect of their comparative distribution, ecology or biology.

Ecology

Bonnet macaques are famous for primarily two reasons—first, their inordinate ability to successfully adapt to almost any kind of environment and second, the intense love–hate relationship that they enjoy with the people of southern India (Schlotterhausen, 1992, 1999). Given these attributes and the fact that they are extremely widespread over the Peninsula, it is truly surprising that our knowledge of the comparative ecology of these macaques in different habitats and their individual and social behavioural patterns remains rather fragmentary (Narain, 1965; Rajagopal, 1965; Rahaman & Parthasarathy, 1969a, 1969b; Singh

& Sachdeva, 1977; Singh & Pirta, 1978; Makwana, 1980; Singh *et al.*, 1980; Singh and Pirta, 1983; Singh & Vinathe, 1990; Ram *et al.*, 2000).

One of the principal reasons that have made the Bonnet macaque ubiquitous in southern India is the wide diversity of food resources that it can successfully use. Bonnets are known to feed on buds, leaves, stems, tendrils, roots, flowers, fruit, seeds and even leaf-galls of different plants, with about 86 species on record in dry deciduous forests (Ali, 1988) and about 39 in tropical evergreen forests (Krishnamani, 1994). They are omnivores and have also been observed feeding on insects (ca. 13% of their diet, Ali, 1988) including crickets, cicadas, caterpillars, termites, spiders and bird eggs. Fruit, however, usually forms the most important component of the diet, followed by foliage and invertebrates. A substantial fraction of their food can also derive from herbs,

Figure 1. Distribution of the northern subspecies—*Macaca radiata radiata*—and the southern subspecies—*M.r.diluta*—of the Bonnet macaque in Peninsular India.



grasses and mushrooms. It must be noted, however, that although most populations are fairly adaptable and exploit a wide variety of plant species, individuals of particular groups tend to monopolize certain species more than others. Thus, only 10 species constituted about 72% of the diet of a troop in a dry evergreen forest (Krishnamani, 1994), while 8 plant species, different grasses and a host of insects accounted for about 76% in a dry deciduous forest (Ali, 1988); only 2 plant species were common between these segments of the diet of the 2 groups.

Demography

Like most macaque species, the Bonnet macaque usually lives in multi-male multi-female troops, with group sizes ranging from 5 to 75 individuals (Roonwal & Mohnot, 1977; Kurup, 1981). Although group size may be highly variable in a particular ecological area, it tends to be much smaller in natural forests and significantly larger in or near human habitations (Krishnan, 1972; Singh *et al.*, 1984; Sinha & Dutta Roy, 2000). Each troop typically consists of one to several adult males and females, and a variable number of sub-adults, juveniles and infants of both sexes. The ratios of different age–sex classes within troops show some variation across ecological habitats (Pirta *et al.*, 1981; Singh *et al.*, 1984; D'Souza & Singh, 1992), the most interesting component being the ratio of adult males to adult females.

The adult sex ratio in primate groups appears to be related to the length of the breeding season and the degree of oestrus synchrony among the females (Ridley, 1986). Bonnet macaques generally live in seasonal environments, and accordingly, most females within

a troop come into oestrus synchronously. Most populations also exhibit a peak birth season, with approximately 93% of the births during February to March (Rahaman & Parthasarathy, 1969b). As compared to the situation in certain other macaques, this seems to have led to a relatively greater proportion of males within natural groups of this seasonally breeding species and correspondingly, a promiscuous mating system. Interestingly, the adult male-female ratio in Bonnets is one of the most variable amongst the macaques, ranging from 0.17 to 5; values greater than 1 represent an unique situation with adult males outnumbering adult females in the troop (Kurup, 1981).

What has never been highlighted before, however, is that Bonnets may be unique amongst seasonally breeding macaques in also exhibiting a fairly high proportion of stable uni-male troops within certain populations (52% in the Bandipur National Park; Sinha & Dutta Roy, 2000). The adult male-female sex ratios in such troops can range from 0.17 to 1 (Kurup, 1981). Preliminary observations indicate that, in comparison to the usual multi-male troops, uni-male groups may be relatively depleted in sub-adult and juvenile males, a clear indication of reproductive monopolization by a single dominant male (Sinha & Dutta Roy, 2000). This is more a characteristic feature of Lion-tailed macaques (Kumar & Kurup, 1985) and Pig-tailed macaques (Oi, 1996), which breed throughout the year, and extremely unusual for a seasonal breeder such as the Bonnet macaque. Further studies should reveal the social dynamics and the behavioural strategies of these troops which have allowed them to co-exist with the more usual multi-male troops, often with overlapping home ranges (Sinha & Dutta Roy, 2000).



Social Behaviour

Bonnet macaque females, like those of many other cercopithecines, remain in their natal group throughout their lives, and during adulthood, form strong, linear dominance hierarchies with daughters occupying dominance ranks just below those of their mothers (Koyama, 1973; Sinha, 1996). Affiliative relationships between females are usually strong, with high levels of allogrooming exchanged between genetic relatives as well as unrelated individuals (Ali, 1981; Kurup, 1988; Sinha, 1996). The exact pattern of allogrooming and other affiliative behaviour displayed by individuals relative to their positions in the dominance hierarchy is, however, extremely variable across different troops (Sinha, *unpublished observations*). In fact, amongst all primates, extensive unreciprocated grooming of subordinate individuals by dominant females has only been observed in Bonnet macaques (Sinha, 1996). Although it is still not clear why such unusual grooming patterns have evolved in this species, they could be determined by ecological conditions, genetic factors, or by idiosyncratic individual choice coupled with cultural transmission of such traits (Sinha, *unpublished observations*).

Juvenile and adult Bonnet macaque males often emigrate from their natal troops to join other troops, another typical cercopithecine feature (Sugiyama, 1971; Simonds, 1974). Bonnet males, however, appear to be unique in being rather unpredictable in this regard, some individuals even staying back to become the most dominant males in their respective natal troops (Ali, 1981; Sinha, *unpublished observations*). Adult males form unstable dominance hierarchies through direct aggression and coalitions, with individuals in most coalitions

demonstrating extensive allogrooming, agonistic support and other affiliative interactions with each other (Simonds, 1974; Sinha, 1998a). The absence of any correlation between individual dominance ranks and the levels of such affiliative behaviour displayed or received, however, indicates that Bonnet males may adopt individual social strategies through coalition formation that are much less constrained by the rank hierarchy than is typical for males of most cercopithecine species living in multi-male groups (Sinha, 1998a).

Strong affiliative relationships rarely develop amongst cercopithecine primate males. The short overlap in residence time that average adult males share with each other, within the natal group or in the new groups that they subsequently join, might make investment in such relationships rather costly. But since Bonnet males often tend to persist in their natal groups well past sexual maturity, strong social bonds may serve to increase inter-individual cohesion between them. A related interesting observation is that Bonnet males actively defend group territories; it is, however, the females that take over the mantle of territorial defense in other macaque species in which males invariably emigrate from their natal troops (Sinha, *unpublished observations*).

Sexual maturity is attained at 3–4 years of age for both sexes in Bonnet macaques (Simonds, 1965), although males become socially mature only 2–3 years later. Sexual swellings are absent in females, but most males within the troop are able to access females in oestrus and inspect them. Adult males appear to follow different sexual strategies, with some males forming consortships of varying periods of time while others simply copulate opportunistically with the available females



(Sinha, *unpublished observations*). Since, as mentioned earlier, males do not invariably transfer out of their natal troops, the levels of inbreeding within groups and whether inbreeding avoidance mechanisms operate at all in these situations remains an open question. Ali (1981), in the only available detailed study of the southern subspecies (*M. diluta*), suggests that low rates of male transfer, extensive inbreeding within the group, a complete lack of sexual consortships, and most striking of all, regular female emigration may be characteristic features of these macaques. Clearly, more detailed comparative studies of the 2 subspecies are required and should reveal the evolutionary origins and life-history implications of these intriguing, but unique, social strategies.

In cercopithecine primates, including macaques, group fission among adult females usually occurs along genealogical lines, with subordinate matrilineal groups breaking away from those more dominant to them. Although well documented in several macaques, nothing is known about this phenomenon in Bonnets. Very little is also known, in general, about the influence of social relationships on individual decisions made during fission. One particular long-term study on the social dynamics of a Bonnet macaque troop prior to fission revealed that the patterns of allogrooming and affiliative interactions between females of different matrilineal groups could correctly predict the subsequent divide within the group (Subramanian & Sinha, 1999). It was also evident from this study that different mechanisms could guide decision-making processes when individual Bonnets make social choices, many of which could have far-reaching effects on their life histories.

Almost Minds?

The development and maintenance of complex social relationships between individuals of different ages, sexes, dominance ranks and kinship groups, as is typical of Bonnet macaques, have been expected to select for enhanced cognitive abilities in individuals living in such groups. Several studies, which have carefully documented various aspects of social communication and cognition in this species, include those on gestural communication (Rahaman & Parthasarathy, 1968; Ali, 1981), vocal communication (Hohmann, 1989), social knowledge of dominance ranks, allogrooming relationships (Sinha, 1998b) and tactical deception (Sinha, 1999, 2000). These studies have provided insight into how cognitively sophisticated decision-making processes and communicative skills could provide an individual with an increasing diversity of potentially competitive social strategies and thus considerably enhance the social complexity demonstrated by the species.

Another aspect of primate intelligence concerns the ability that monkeys may have possibly evolved in response to the mechanical and technical challenges of their environment: the manufacture and use of tools. From an evolutionary point of view, tool-using abilities are believed to have originated as adaptations for omnivorous extractive foraging on embedded foods and many macaque species, which are generalist foragers on fruit and foliage, have been considered poor tool users. Bonnet macaques, however, do have the potential to elaborate tools under different, more specific, contexts (Sinha, 1997). In fact, the complex nature of tool manufacture shown by a particular individual suggests that sophisticated



cognitive abilities, involving mental representation, may underlie active object manipulation by these monkeys.

Current Research on Bonnet Macaques

Much of the earlier work on the natural history of wild Bonnet macaque troops by Parthasarathy and his colleagues of Bangalore University was conducted around and within the city itself. Following their pioneering work, Singh and his co-workers in Mysore University, Ali in Bristol University, UK, and Kurup of the Zoological Survey of India carried out extensive research on the ecology, demography and behaviour of the species in different parts of southern India; much of this work was published in the early and mid-1980s. Of these, Ali's work is particularly important because it remains, to this day, the only detailed study on the ecology and social biology of the southern subspecies, *M. r. diluta*. Remarkably, Singh's group in Mysore has been continuing its work on the ecology and behaviour of the Bonnet macaque, particularly in the Anaimalai Hills of the Western Ghats. Our own research at the National Institute of Advanced Studies, Bangalore, has primarily focussed on the demography, social behaviour and cognitive psychology of free-ranging troops in the Bandipur, Mudumalai, and Kalakad–Mundanthurai Wildlife Sanctuaries, and urban troops around Bangalore and Mysore.

Conservation Threats and Management Strategies

A striking feature of Bonnet macaques, commented on by various authors, is their inherent tendency to gravitate towards human habitations and the associated habit of becoming relatively more terrestrial rather than remain-

ing truly arboreal (Nolte, 1955; Simonds, 1965; Sugiyama, 1971; Krishnan, 1972; Kurup, 1981; Pirta *et al.*, 1981; D'Souza & Singh, 1992). In fact, significant populations of completely wild Bonnet macaques in interior forests have rarely been reported. Most urbanized macaques have managed to coexist with the local people in a wide variety of non-forest habitats, including tea and coffee plantations, village agricultural areas, temples and fully urban settings (Simonds, 1965; Schlotterhausen, 1992). This has often naturally led to serious conflict between the monkeys and the people whose crops and homes they raid; such situations continue to remain problematic even today.

It has been estimated that the total population of Bonnet macaques in the 4 south Indian states would be to the order of 1,70,000, with about 81,000 monkeys in Karnataka, 64,000 in Andhra Pradesh, 16,000 in Tamil Nadu and 11,000 in Kerala (Kurup, 1981). The Bonnet macaque populations in Gujarat and Maharashtra have never been monitored. What also remains unknown is the rate of decline of many of these populations that seems inevitable given the intensification of agriculture in rural areas and the increasing intolerance towards the species in urban localities. Yet another problem plaguing Bonnet macaque populations today and one that is likely to become even more serious in the future is the capture of free-ranging monkeys by professional trappers to meet the increasing demand of laboratories involved in biomedical and other research (Sinha, *personal observations*). Care must be taken that this situation does not burgeon into a problem of the kind faced by the Rhesus macaque of northern India, Pakistan and Bangladesh about two decades ago when increasing demand for the species in the developed countries and our export policy to meet



this demand severely threatened most of its natural populations.

Long-term monitoring of certain Bonnet populations around Mysore in Karnataka have, in fact, revealed that during the last two decades several groups of monkeys have been completely eliminated and that some areas that had abundant populations earlier are now completely devoid of them (M. Singh, *pers. comm.*). It is entirely possible that in such a scenario the common Bonnet macaque of today may well become an endangered species of tomorrow.

There does not, however, appear to be any clear or unique solution to a situation that could become critical in the near future. The problem of human–Bonnet conflict in urban areas has often been addressed through the capture of the offending troops and their translocation to natural forests, a process beset by a variety of problems. The foremost of these lies in the unique psychology of the species that compels it to move into human habitations and quickly adapt to the prevailing conditions there. Given the abundance of Bonnet macaques in any favourable environment, other groups soon move into areas vacated by the captured troops. It is also difficult to identify suitable areas where the captured groups can be introduced since this, more often than not, results in ‘transferring the problem to someone else’ (S. Baksi-Ganguly, *pers. comm.*). Moreover, translocation into protected areas, as is often practised by the local administration (M. Singh, *pers. comm.*), is completely inadvisable for fear of exposing the local Bonnet populations to foreign infections and disease.

Perhaps the most practical solution to the problem of urban Bonnet macaques is to develop management strategies *in situ*. It might

be possible, for example, to examine the effect of introducing local feeding stations with the aim of attracting monkeys away from raids on residential areas. A protocol of capture, sterilization and re-introduction of the monkeys into the same localities has also been sporadically practised (S. Baksi-Ganguly, *pers. comm.*), but its effect on the socioecology of the troops or the nature of their subsequent interactions with the local people has never been examined.

It is therefore clearly imperative that more detailed ecological and behavioural studies of wild, semi-urban and urban Bonnet macaques be initiated urgently. Such studies are essential if successful management strategies are to be developed for the species, not only in protected forest areas where the monkeys tend to interact increasingly with tourists (Ram & Sinha, 2000), but also in rural and urban areas where rapidly growing human populations are coming into serious conflict with the macaques with very little or almost no hope for the survival of the monkeys.

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The Lion-tailed Macaque (*Macaca silenus*): Life History, Ecology, Distribution and Conservation

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Introduction

The Lion-tailed macaque (Family: Cercopithecidae) is endemic to the tropical rainforest of the Western Ghats. It is considered the ancestor of all Asian macaques, since it is probably the direct descendent of the first macaque to reach Asia (*Macaca paleoindica*), nearly 5 million years ago, more or less the time when man evolved. This ancestor, the fossils of which have been obtained from Shiwalik Hills, is thought to have reached Southeast Asia through southern India. Geo-climatic changes during the Pleistocene, especially glaciation and the monsoonal climate, isolated the ancestral stock to the Western Ghats, whereas the stock which had reached Southeast Asia underwent repeated speciation to give rise to most of the extant macaques. The Lion-tailed macaque is a descendant of that stock which was isolated in the Western Ghats. Having been isolated in the tropical rainforests for all its life, the species shows striking adaptations to this habitat.

Practically unknown until the 1960s, there have

Abstract

The Lion-tailed macaque, endemic to the rainforest of the Western Ghats, is the ancestor of all Asian macaques. It occurs from slightly north of the Sharavati River in Karnataka to the southernmost tip of the Western Ghats, with a current population of ca. 4,000 animals, that are highly fragmented. The mean group size is 18–19 animals, usually with one adult male and 5–6 adult females. The macaque is adapted to the stability of rainforests, with a low capability to recover from drastic population reductions. Plant species richness in its habitat is critical in providing year round fruit and seeds, as well as foliage invertebrates. The home range varies from 125 to 500 ha, reflecting the difference in habitat quality. Pregnancy lasts about 170 days, and births peak in December–February. Although the vocal repertoire is similar to that of other macaques, the whoop and copulatory calls are unique.

The populations in forest fragments carry a high risk of extinction, a major determinant of which is the quality of the fragment and surrounding vegetation, rather than the

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fragment area. Management of these populations and their habitat is critically important. Some of the most important measures needed are discussed in the present communication. The rainforest fragments, which harbour a rich fauna, are of immense conservation value and can also be a major source of income from eco-tourism, if properly supported, encouraged, and managed.

been several studies on the species following Sugiyama's 3-month pilot study in the Cardamom Hills. There are several reports on its distribution and population status (Sugiyama, 1968; Green & Minkowski, 1977; Kurup, 1978; Ali, 1985; Karanth, 1985; Bhat, 1994; Kurup, 1994; Ramachandran, 1994; Kumar *et al.*, 1995); long term studies on its ecology, demography and behaviour in Ashambu Hills (Green & Minkowski, 1977), Anamalai Hills (Kumar, 1987; Kumar & Kurup, 1985; Kurup & Kumar, 1994; Menon, 1993), and Silent Valley (Joseph, 1998); vocalization; impacts of habitat fragmentation (Umapathy, 1998; Umapathy & Kumar, 2000); and recently, on social development and reproductive behaviour. Thus, we have a better understanding of the life history, ecology, behaviour, distribution and conservation problems of the Lion-tailed macaque, than of most other species in India.

Life History

The Lion-tailed macaque lives in groups with an average of about 18 animals (mean 18.8 and the median 17.4). In undisturbed habitats the group size ranges from 7 to about 40. However, in forest fragments in the Anamalai Hills group size may be as high as 65 animals. Most of the groups in undisturbed forests have only one adult male (mean 1.5, median 1), with 6 or 7 adult females and one sub-adult male,

the remaining being immature. However, groups with as many as 4 adult males occur in forest fragments. The mean group size of the Lion-tailed macaque is slightly smaller than that reported for other macaques, in the range of 20–30 animals. Moreover, the adult sex ratio in a group is more biased towards the females, with about 5–6 females per male compared to 2–3 females per male reported for most other macaques. There is no indication of geographical variation in group size and composition. For example, the populations south and north of the Palghat Gap have similar group sizes (18.4 and 19.1 respectively). Their age/sex compositions are also not significantly different.

Information on other life history parameters comes almost entirely from the Anamalai Hills, where the species has been studied for over a decade. The Lion-tailed macaque has a very low birth rate (the proportion of females giving birth in a year) compared to most other macaques. Data from 8 groups gave a birth rate of only 0.30 (SD = 0.07). Consequently the inter-birth interval is very long; data from 3 females gave a mean of 30 months or two and a half years. The age at which females give birth for the first time is also unusually high (6.6 years, $n = 3$) compared to other macaques. The only redeeming feature of its life history seems to be the very low mortality rate, only about 0.05/year for all age/sex classes together. Adult males probably have a greater mortality or emigration rate (0.08/year), compared to adult females (0.03/year) and immatures (0.05/year).

Most of the mating in the Lion-tailed macaque occurs when the female is in estrus, which is indicated by a swelling in the perineal area, especially at the base of the tail. The duration of the sexual cycle is on an average 30 days,



with a swelling phase of 14 days and a flat phase of 16 days. Mating reaches a peak about 11–13 days after the swelling appears.

The life history parameters of the Lion-tailed macaque are exceptional compared to other macaques. The high age at first birth, low birth rate, and low mortality rates at all stages of life are noteworthy features, and highly adapted to its relatively stable habitat. The inevitable consequence of the above set of parameters is that the Lion-tailed macaque would have very low capability to track rapid changes in resources and to recover from population perturbations caused, for example, by diseases or hunting.

Feeding Ecology

The Lion-tailed macaque feeds exclusively on food items which are rich in simple carbohydrates or lipids (ripe fruit, seeds, nectar, gums and resins), and proteins (chiefly invertebrates, but could also include bird eggs and nestlings, and giant squirrels). The annual diet consists of 57.5% of fruit and seeds, 37.3% of animal matter, and 5% of other plant parts such as nectar, resins and flowers. Nearly 220 plant species are used for food in 3 sites together (Kalakad, Silent Valley and Anamalai Hills). Over a 3-year period, one group in the Anamalai Hills used 93 plant species belonging to 39 families, with the number of species used each month varying from 8 to 25. Most species (56.0% in the Anamalai Hills) are exploited only for the ripe fruit flesh (e.g., *Mangifera indica* and *Semicarpus travancorica*) but many species (16.5%) are also used for their seeds. Few species (e.g., *Artocarpus hirsuta* and *A. integrifolia*) are used for both the seed and the mesocarp, and few others for nectar (e.g., *Bombax malabarica*). Gums or resins of few species are also used (e.g.,

Gnetum ulae and *Vepris bilocularis*). The only species exploited for its flowers is *Xanthophyllum flavescens*. Other plant food items include mushrooms, lichens, and mosses. Feeding on leaves is negligible and confined to infrequent and short bouts of feeding on some grass species.

Most of its protein requirements are met primarily from invertebrates, but it also feeds opportunistically on snails, birds eggs, nestlings, and giant squirrel nestlings. It spends considerable time looking for invertebrates (mean = 27.4% of daytime) and feeding on them (mean = 18%). Green leaves are, by far, the major source of invertebrates (77.2%).

Thus, the diet is dominated by plant parts (fruit flesh and seeds) rich in simple carbohydrates, and foliage insects rich in protein. The availability of fruit and seeds, and green foliage throughout the year, therefore, is critical to the survival of the Lion-tailed macaque. Only the very high diversity of plant species in the rainforests can ensure the availability of fruit and seeds, and invertebrates throughout the year. The same high plant species diversity also buffers against variations between years in the availability of fruit, seeds and invertebrates.

Distribution

Even within historical times, the Lion-tailed macaque was distributed as a contiguous population from the southern end of the Western Ghats to well into the state of Maharashtra. Over the past many centuries, however, its distribution range in the north has shrunk to just north of the Sharavati River in Karnataka, as most of the rainforests in the states of Maharashtra and Goa were wiped out. Similarly, the lowland rainforests in Kerala and Karnataka were also wiped out, confining the



Lion-tailed macaque to higher elevations. Moreover, the remaining forests have been fragmented into numerous small isolated patches. Presently, therefore, the Lion-tailed macaque occurs as numerous small populations (Figure 1).

Karnataka

In Karnataka, it occurs from slightly north of the Sharavati River up to the southernmost part, Srimangala Forest Range, adjoining Kotiyur forests in Kerala. The narrow band of rainforest on the western face of the Western Ghats in Karnataka is largely contiguous through most of its length. Four populations can be identified in Karnataka.

1. North of the Sharavati River and south of the Aghanashini River is a remnant population mostly in the Siddapur Forest Range. A small population might also occur in the Kumta Range. The habitat is highly fragmented, and has been surveyed by Bhat (1994).
2. South of the Sharavati River, the habitat is largely contiguous up to Belthangadi Range. The Wildlife Sanctuaries and Forest Ranges included in this area are: Sharavati, Mookambika and Someshwara Wildlife Sanctuaries, Kudremukh National Park, and Forest Ranges of Shankaranarayana, Hosanagara, Agumbe, Karkala, Mudbidri, Kudremukh, Sringeri, and Kalasa. This stretch is however cut by at least 3 state highways, making it discontinuous. Large stretches of rainforests occur at low elevations in Mookambika, Someshwara and Shankaranarayana ranges.
3. The above population is separated from the large stretches of contiguous forest in Kodagu district, by a large discontinuous

section in the Belthangadi and Mudigere ranges. There is, however, a small remnant population in the Charmadi Hills of the Belthangadi range.

4. South of the Mangalore–Sakleshpur road, the habitat is again contiguous and mostly at a low elevation, extending up to Kotiyur forests in Kerala. Most of these forests fall in Kodagu district. This area covers forest ranges of Subramanya, Sampaji, Bhagamandla, Makut, Mundrote, and Srimangala. Three state highways, however, cut across this area, creating discontinuous stretches. In terms of habitat quality, this is undoubtedly the best in Karnataka, being the southernmost, at a low elevation and not logged intensively. However, the population has been severely suppressed by poaching from Kerala and Kodagu sides. The population density is therefore, very low.

A rough estimate of the area of the Lion-tailed macaque's habitat in Karnataka is possible from Pascal *et al.*, (1982). The area under each vegetation type and the estimated population are given in Table 1. Working groups estimated the population in each area during the 4th International Symposium on the Lion-tailed Macaque held in Chennai in 1993 (Kumar *et al.*, 1995).

Kerala and Tamil Nadu

Compared to Karnataka, the rainforests in Tamil Nadu and Kerala occur at a higher elevation, mostly above 700 m. The best quality low elevation habitats have all been cleared. An assessment is severely handicapped because of the absence of a vegetation map comparable to the one available for Karnataka. Although Kerala accounts for nearly 50% of the population and Tamil Nadu for 25%, in both these



Table 1. The distribution of lion-tailed macaques in the different vegetation associations in rainforests in Karnataka. The vegetation association follows Pascal (1988) and the area was estimated from the vegetation map (Pascal 1982). Population estimates are from Kumar (1995). (Altitude: low = 0–850 m, med = 600–1400 m).

Population	Vegetation type	Altitude	Area (Km ²)	Est. LTM groups
North of Sharavati River	<i>Persea macarantha</i> - <i>Diosphros</i> - <i>Holigarna</i> spp;	Low	80	
	<i>Dipterocarpus indicus</i> - <i>Diospyros candolleana</i> - <i>Diospyros occarpa</i> ;	Low	30	
Total			110	10
Mookambika–Someshwara area	<i>Dipterocarpus indicus</i> - <i>Diospyros candolleana</i> - <i>Diospyros occarpa</i> ;	Low	235	
	<i>Poeciloneuron indicum</i> facies of above <i>Dipterocarpus indicus</i> - <i>Humboldtia brunonis</i> - <i>Poeciloneuron indicum</i> ;	Low Low	187 138	
	<i>Palaquium ellipticum</i> - <i>Poeciloneuron indicum</i> - <i>Hopea ponga</i> ;	Med	70	
	<i>Dipterocarpus indicus</i> - <i>Kingiodendron pinnatum</i> - <i>Humboldtia brunonis</i> - <i>Poeciloneuron indicum</i> ;	Low	75	
Total area			705	26
Charmadi Hills	<i>Dipterocarpus indicus</i> - <i>Kingiodendron pinnatum</i> - <i>Humboldtia brunonis</i> ;	Low	24	2
Kodagu area	<i>Dipterocarpus indicus</i> - <i>Kingiodendron pinnatum</i> - <i>Humboldtia brunonis</i> ;	Low	697	
	<i>Mesua ferrea</i> - <i>Palaquium ellipticum</i> ;	Med	324	
	<i>Cullenia exarillata</i> - <i>Mesua ferrea</i> - <i>Palaquium ellipticum</i>	Med	30	
Total area			1051	10

states the habitat and populations have been severely fragmented. The only exceptions are Silent Valley–New Amarambalam area, Ashambu Hills, and to some extent, the Cardamom Hills. There are about 7 populations in these 2 states together, but except in the 3 areas just mentioned the population is further fragmented into smaller populations (Table 2).

1. North of Nilambur: This population is confined to Kerala. The northernmost is the Kotiyur forest in Kannothe Range, which is

contiguous with the Kodagu population in Karnataka. The extent of forest in Kerala is however very small (> 20 km²). There are 3 other isolated populations, with 1–4 groups each, in Periyar, Manjeri Kovilakam and Nadukani. Some of these habitats have been underplanted with cardamom, and all populations are under poaching pressure.

2. Silent Valley–New Amarambalam: This is also entirely confined to Kerala, and is the largest population in the state, and the best

Table 2. The distribution and approximate population of Lion-tailed macaque (from Kumar *et al.* 1995) in Kerala and Tamil Nadu.

Population	Kerala	Tamil Nadu	No. of groups groups	Remarks
North of Nilambur	Kotiyur, Periya, Manjeri-Kovilakam, Nadukani	–	4–8	Fragmented
Silent Valley New amarambalam	Silent Valley & New Amarambalam	–	> 30	Contiguous population
Siruvani- Attapadi	Siruvani & Attapadi area	Boluvampatti	4–5	Contiguous population
Anamalai Hills	Nelliampathi RF Parambikulam WLS Sholayar RF	Indira Gandhi WLS, private forests	43–58	Highly fragmented 1–5 groups each
Munnar	Pappathi, Vattavada	–	1–2	One small fragment
Cardamom Hills	Periyar Tiger Reserve, Ranni & Konni forest Divisions	Megani Valley, Srivilliputhur	21	Fragmented into 3–4 populations
South of Achankoil	Thenmala, Chendurany & Peppara WLS, Neyyar WLS, Kulathpuzha	Kalakkad- Mundanthurai Tiger Reserve	50–55	Contiguous in Tamil Nadu, Fragmented in Kerala, but contiguous with Tamil Nadu

habitat in terms of quality and contiguity. The population is estimated to be about 600 animals (30 groups). Although relatively free from major habitat loss, poaching has been reported recently.

3. Siruvani–Attapadi: Although contiguous with the Silent Valley population till recently, this is now an isolated population. At an elevation of above 900 m, the Colleen dominated forest has a population of about 3–5 groups.
4. Anamalai Hills: This area probably had the largest extent of rainforests in Western Ghats, until about 200 years back. Large areas were cleared for reservoirs, plantations, and tea and coffee estates. Presently the Lion-tailed macaque habitat is highly fragmented and surrounded by tea estates. Many of the patches are at a low elevation

(600–700 m), compared to other parts in these two states, and therefore the density is relatively higher than in most other areas, including the higher elevation forests in the much southern Ashambu Hills. The total population in the Anamalai Hills is probably about 23–32 groups in Kerala and 20–27 groups in Tamil Nadu, with nearly 800 animals in total. Except for the Karimala Gopuram–Sholayar forests, with about 12–16 groups, the remaining populations are all small, mostly with 1–2 groups, isolated in forest fragments ranging an area from 15 ha to 2000 ha. Some of these fragments are also under private ownership and highly degraded (Puthuthottam and Korangumudi estates). While most of the areas in Tamil Nadu fall within the Indira Gandhi Wildlife Sanctuary, large areas in Kerala are out-



side the Parambikulam Wildlife Sanctuary.

5. Munnar: Most of the forests in Munnar have been cleared for tea estates and those that remain are at high elevations and not suitable for Lion-tailed macaques. Perhaps the only remnant population (of 1–2 groups) is in the Pappathi Shola.
6. Cardamom Hills: Most of the rainforests in Cardamom Hills are in Kerala, in the Periyar Tiger Reserve, and Ranni and Konni Forest Divisions. Although the estimated population is about 17 groups, and the habitat area about 250 km² a considerable extent of these forests is either semi-evergreen or at high elevations, which may not be optimal Lion-tailed macaque habitat. There is also a small, and probably isolated, population (of about 4 groups) on the eastern side in Tamil Nadu (Sirivilliputhur).
7. South of Achankoil and Ashambu Hills: The forests in Kerala, south of Achankoil, are perhaps contiguous with extensive forests in Ashambu hills, which largely fall in Tamil Nadu. The total population is estimated to be about 50–55 groups—nearly 25% of the entire Lion-tailed macaque population. The forests in Tamil Nadu have retained their contiguity in the Ashambu Hills and isolated small populations are not likely. In Kerala, there has been extensive forest loss, and small isolated populations are likely, although the southern part of this range is contiguous with Tamil Nadu.



Conservation Problems

The major problems in the conservation of the Lion-tailed Macaque are:

1. **Habitat and Population Fragmentation:**

Most of the rainforests in the Western Ghats have been lost and the remaining habitat

occurs mostly as small patches with 1–4 groups each. During the 4th International Symposium (Kumar *et al.* 1995) the Working Group on Census and Distribution identified at least 40 isolated populations, of which 26 had less than 2 groups each, 9 had between 3 and 10 groups, and only 5 had more than 10 groups. The areas with substantial, but fragmented, populations are Anamalai Hills and Cardamom Hills. Charamadi Hills in Karnataka and north of Nilambur in Kerala, also have a few small populations confined to small patches of habitat. In Kodagu area, a small population is confined to a large stretch of habitat, a consequence of many years of hunting pressure. South of Achankoil also there might be isolated small populations in Kerala.

A recent study in the Anamalai Hills has shown that Lion-tailed macaques often become extinct from small habitat fragments (Umapathy & Kumar, 2000). Moreover, isolated populations have a low birth rate and a lower proportion of immatures.

2. Hunting: Poaching is a serious problem in certain places. It had been prevalent in Kodagu forests for many years. As a result, the population in this ideal habitat has been reduced drastically. Hunting is also a problem in north of Nilambur, and in Cardamom Hills. Recently, hunting has also been reported from the Silent Valley Area. Given the low birth rate and high age at first birth, the Lion-tailed macaque does not have the ability to recover from even low levels of hunting.

3. Habitat Degradation: Almost all the small patches of rainforests have been degraded due to logging, cardamom planting, and fuel and timber wood collection. Logging has already reduced the population in some patches in recent years (Puthutottam and Korangumudi

estates), and continues to be the major and immediate threat to many small populations in Anamalai, Manjeri Kovilakam forests in Nilambur, and Srivilliputhur.

2. Private Ownership: Many of the small patches are under private ownership, especially in the Anamalai, Cardamom, and Ashambu Hills. This offers the Lion-tailed macaque and its habitat very low protection from logging, poaching, fuel wood collection. Logging in such privately owned patches has become a serious threat to resident populations in recent years.

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Ecology and Conservation of Nilgiri Langur (*Trachypithecus johnii*)

S.F. Wesley Sunderraj¹

Introduction

Nilgiri langur (*Trachypithecus johnii* Fischer 1829), the black leaf monkey, is endemic to the rainforests of the Western Ghats of Tamil Nadu and Kerala, and to the hills of Coorg in Karnataka. It is one of the 18 species of Asian leaf monkeys belonging to the family; Cercopithecidae and sub-family Colobinae. Its closest relative is one of the 4 subspecies of the Purple-faced leaf monkey, which is *Trachypithecus vetulus vetulus* (Hill 1934) found in the southern part of Ceylon. The Nilgiri langur (NL) is truly arboreal in nature and usually found in tropical evergreen forests at elevations > 500 m. However, in the Tirunelveli Hills of Tamil Nadu, it is even found even in the foothills (McCann, 1933), where the riverine forest is contiguous with the forests of the upper reaches. NLs are seen in the low elevation riverine habitats of the Mundanthurai Plateau (M-plateau), at an elevation of 180 m in the Kalakad–Mundanthurai Tiger Reserve (KMTR) in Tamil Nadu mainly along the perennial Tambiraparani and Servalar rivers, which were earlier contiguous with the evergreen habitat of the higher elevations. The continuity

Abstract

Nilgiri langurs are endemic to the rainforests of the Western Ghats of South India. A detailed study of the Nilgiri langur was carried out on an isolated population in a low elevation riparian habitat at the Mundanthurai plateau (KMTR) between 1984–88. The present communication highlights their population, demographic parameters and the feeding ecology and compares these with other studies on this species carried out at higher elevations. Threats to this population, largely due to habitat destruction and increasing human populations in the area, are also discussed. Suggestions on the restoration of habitat and the need for greater protection and awareness among the local people, are stressed.

of the habitat was broken by the construction of two reservoirs across these rivers and has lead to the isolation of nearly 200 Nilgiri langurs from the population of the upper reaches.

The NL is vulnerable both at the national (ZSI, 1994) and global (IUCN, 2000) levels. These langurs are threatened due to severe pressure from poaching for supposedly medicinal



¹Adapted from : Sunderraj, S.F.W. 1998. The ecology of the Endangered Nilgiri langur (*Presbytis johnii*) on Mundanthurai plateau, Kalakad Mundanthurai Tiger Reserve, Tamil Nadu. Unpublished Ph.D thesis, Saurashtra University, Rajkot, Gujarat, India.

properties of its meat and habitat destruction for timber and firewood extraction. These threats are common for both the upper and foothill populations and still continue to pose a problem both within and outside Protected Areas (Hohmann & Sunderraj, 1990; Sunderraj & Johnsingh, 2001). Even though many studies have been carried out on NLs, most of them are status surveys (Daniel & Kannan, 1967; Krishnan 1972; Kurup 1975; Oates 1978), morphometry (Leigh, 1926) and seasonality in breeding (Tanaka, 1965). There have been only 3 studies on the ecology and behaviour of this primate, and all 3 were carried out at elevations > 1000 m (Poirier, 1970; Horwich, 1972; Oates *et al.*, 1980). There has been only a single, long-term study on the ecology of the isolated population of NLs in the foothills of the M-plateau, KMTR between 1984 and 1988. Most of the ecological information presented in this article is largely from this study (Sunderraj, 1998).

Morphology

The body of the NL is glossy black with thick and long hair. The head is covered by yellowish-brown or golden hair, and the rump and base of the tail are grizzled. The females have a white patch on the inside of the thighs, which is distinct even in a week-old female infant. Newborn infants have pale pink skin covered with reddish-brown hair. The infants attain the colour of the adults at around 3 months of age. The head and body of an adult male measure about 75 cm and of an adult female 58 cm. Nilgiri langurs have a fairly long tail and the length varies from 68.5–96.5 cm. The average male weighs ca. 9.1 kg, while that of the females varies from 10.9–11.3 kg. (Leigh, 1926; Poirier, 1970, 1971). Newborn young weigh about 0.5 kg (Sankhala & Desai, 1969).

Distribution

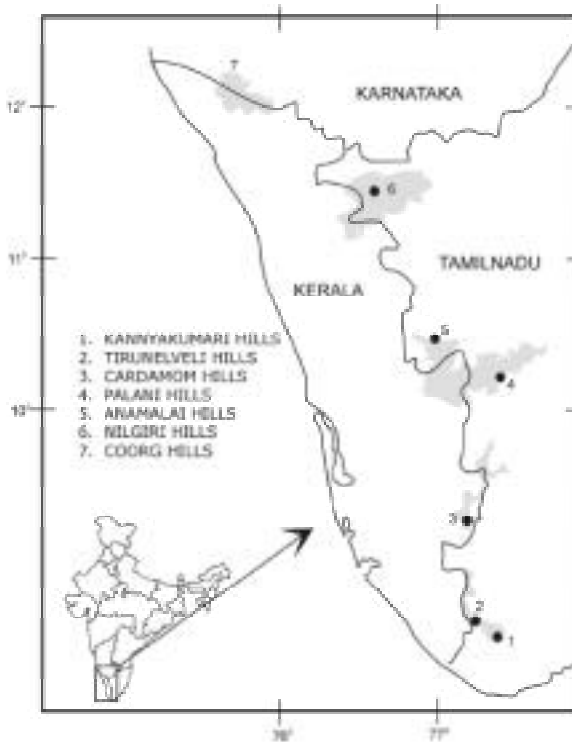
The distribution of the NL is from the Kanyakumari hills in the southern tip of the Indian Peninsula to the Coorg Hills in Karnataka, which form the northern limits of its range. The major areas with langur populations are the Ashambu Hills (which include Kanyakumari and Tirunelveli Hills) Periyar Tiger Reserve, Cardamom, Palani, Anamalai, Nilgiri and Coorg Hills (Figure 1). The distribution is restricted to 8°–12° N and 76°–77° 30' E (Oates, 1979). The present population estimate for its entire distributional range is not available and the status information that is available is restricted to a particular range (Hohmann & Sunderraj, 1990; Ramachandran & Joseph, 2001). Survey of NLs and Lion-tailed macaques in selected areas of Tamil Nadu showed that the langur population corresponds well with the status of protection of the respective areas surveyed (Hohmann & Sunderraj, 1990). Even though evidence of poaching was reported within the Protected Areas, the presence of a high population density suggests that this practice was not a serious threat. Since poaching and habitat destruction still continue within and outside the Protected Areas, the information on the status (a decade old) cannot be overlooked. Details of the population densities estimated for 4 areas are given in Table 1.

Population and Demography

Group size

On the M-plateau, NLs live in small populations, with a mean of 18.5 groups, the group size varying from 5 to 24 with a mean group size of 10 animals/group. However, there was a difference in the range of group sizes when compared to Webb-People (1947) 20–30, Krishnan (1972) 4–12, and Ramachandran & Joseph (2001) 1–14 individuals, The group



Fig. 1. Distribution of Nilgiri langur population

size of the foothills population (M-plateau) was close to the group sizes (3–25 and mean size of 8–9) reported by Poirier (1970). Surveys conducted during the late 80s (1987–1989) in the higher elevations (> 500 m) of the

Agastyamalai, Srivilliputtur, Anamalai and Avalanche (Nilgiri, south division) areas also reported a similar range in group size (4–24), with a smaller mean group size of 7.6 individuals (Hohmann & Sunderraj, 1990). Thus, it is evident that NLs live in smaller groups without much variation in group sizes along their distributional range.

Social organization

NL groups are organized into one or uni-male (only one adult male with more of other age and sex classes), multi-male, all-male and all-female groups. On the M-plateau langur groups varied from the multi-male characteristic exhibited by other primate species, with only one adult male in each group. The same social patterns have also been reported in the higher elevations by Poirier (1970) and Hohmann & Sunderraj (1990). However, multi-male and all-female groups are not common in NLs. At the sub-adult stage, when males start fighting for access to females, they are displaced by dominant males and forced to migrate (Dittus,

**Table 1. Estimates of *Trachypithecus johnii* population densities in the selected areas of Tamil Nadu (Hohmann & Sunderraj, 1990)**

	Areas Surveyed			
	KMTR	Srivilliputtur	Ulandhi (Anamalais)	Avalanche (Nilgiri South)
No. of Groups/km (trail survey)	.39	.76	.08	.15
Mean Group Size	4.36	7.24	5.40	8.00
All Male/Mixed Group Ratio	1:10	1:14	0*	1:9
No. of Groups/km (acoustic survey)				
Population Density–Groups/km ²	1.98	2.15	.52	.29
Extension of Potential Habitat	650	600	150	800
Estimated Population				
No. of Groups	1.290	1288	79	232
No. of Individuals	5,625	9,325	426	1,856

* all mixed groups.

1979). In almost all primate species most emigrants are adult or sub-adult males (Altmann & Altmann, 1979). As only all-male groups were seen on the M-plateau, male emigration rather than female emigration (Ali *et al.*, 1985) may possibly be a characteristic feature of their life-history strategy.

Age and sex ratio

There was no clear pattern in the age and sex composition of the NL populations between the foothill and higher elevation forests. The age–sex composition determined during this study revealed a female-biased sex ratio, with 100 adult females to 40 adult males. A similar proportion was also reported by Ramachandran & Joseph (2001), with 100 females:50 males from the Silent Valley National Park at elevations ranging from 658–2,383 m. This is rather a highly skewed sex ratio when compared with Poirier's (1970) study (100 females:83 males). On the other hand, the adult (Adults and sub-adults) to immature (infants and juveniles) ratio showed a considerably bias towards the adults (100 adults:34 immatures) at higher elevations (Poirier, 1970) compared to that reported from the low elevations/foothills of the M-plateau (100:57).

Birth season

The seasonality of birth in NLs (8 groups observed from 1985 to 1988) showed 2 distinct peaks. The primary peak was in May when 17 brown infants were recorded. The second peak occurred in November with the birth of 11 more infants. These 28 infants formed 45% of the total 63 infants born during the 3 years. Nevertheless, some brown infants were recorded round the year, except during February and August. This seasonality could be related to the seasonality of food availability in the M-

plateau. The months of May and November were characterized by fresh leaf sprouts and growth following the southwest and northeast monsoons, and the peak in births coincides with this. Even in rainforests, NLs showed prominent peaks during the same months (Poirier, 1970). Birth seasons of the various populations of the NLs along its distributional range show a general similarity. Observation of birth peak in 2 subspecies of the Purple-faced leaf monkey (*Presbytis senex*), a close relative of the NL was also influenced by the food availability (Rudran, 1973).

Birth, death and population growth rate

A total of 63 infants were born in the 8 groups monitored between 1985 and 1988, with a gross average birth rate of 0.56 infants/female/year. Across the group, the birth rate varied from a low of 0.25 to a high of 0.83 infants/female/year. However, birth rates did not differ significantly between years. Birth rates in the M-plateau population seemed to be low when compared to the population living at higher elevations (0.70; Poirier, 1970). The mean death rate estimated from 10 groups showed the rate of 0.34 animal/year (excluding poaching of 10 animals) and varied significantly between years. When the incidents of poaching were also included (a major threat and one that is most detrimental, directly influencing the population growth), the death rate increased to 0.47 animals/year.

Low birth rate coupled with biotic disturbances, influenced the death rate considerably, resulting in a very low population growth rate in the foothill population. However, the monitoring of 10 groups from 1985 to 88 showed an overall growth rate of 0.07, the groups living in highly disturbed areas showing a decreasing trend.



Feeding

Feeding activity

The annual activity budget of NLs, showed that 43.65% of time was spent on feeding (N = 27,958). Monthly feeding varied from a maximum of 48.61% to a minimum of 37.88%, while no significant difference was observed in feeding across seasons. Diurnal distribution of feeding activity over the year showed clear bi-modal peaks. NLs spent more time on feeding during morning (48.96%) and evening (55.77%) than midday. This can be explained by the fact that the NLs needed to compensate for the long hours of non-feeding during the night to gain the necessary energy levels. A similar pattern was observed in *Presbytis geei* (Wangchuk, 1995; Gupta & Chivers, 2000) and in *T. melalophas* (Curtins, 1980).

Food plants

The NL has the tendency to exploit the maximum resources available within its home range for its food. A total of 102 plant species were identified as food plants used by the 2 groups (24 months observation), with ca. 72% of these plant species available within their home ranges. It is further true, from the higher elevation study that, within 9 months a total of 115 plant species were documented as food plants (Oates *et al.*, 1980). The number of food plants used by NLs varied in the different studies: 39 by Horwich (1972), 52 by Poirier (1969) and 29 by Srivastava *et al.*, (1996). Feeding on diverse food plants by NLs clearly indicates its high adaptability to the given habitat. It has been reported that NLs easily accept new diets when their home ranges change (Poirier, 1968; 1969). In the riverine habitat, the major food resource of NLs comes from trees (74%, 76 species), with few climbers (17%, 17 species) and shrubs (9%, 9 species).

NLs on the M-plateau can be judged as generalist–flovore. On the whole, they spent little over half of their time (55.65%) feeding on the top 10 species. A comparison with other Colobines (*P. senex*-Rudran, 1970; *P. entellus* and *P. senex*-Hladik, 1977; *C. badius*-Marsh, 1981a and *P. phayrei*-Gupta & Kumar, 1994) showed that, the former spent more time feeding on comparatively less number of species, while the rainforest study showed that langurs are more selective in their diet (Oates *et al.*, 1980). Comparison of 15 top food species showed that 13 species were common between the years and 9 species between groups. Therefore these 9 species—*Derris pinnata*, *Terminalia bellerica*, *Syzygium cumini*, *Tamarindus indica*, *Albizia lebbeck*, *A. amara*, *Dalbergia paniculata*, *Acacia pennata* and *Commiphora caudate*—can be considered as key species for the survival of NLs in the riverine forest of the low elevations.

Among these species *Derris pinnata*, *Terminalia bellerica* were the staple food resources and they were the top 2 species between the years and groups. On the whole they constituted 22.18% of the total feeding records.

Food items

NLs utilized 219 food items from 102 plant species and the major dietic composition consisted of young leaves (44.06%), mature leaves (4.21%), flowers (8.44%), young fruit (10.51%), ripe fruit (4.59%), seeds (18.61%) and other minor food items (9.57%). These minor food items include petioles, bark, pith, insects (mainly termites), soil gum and dead wood. A study of monthly feeding on different food items revealed that the young leaves dominated the diet in most of the months sampled (29 months out of 36 months). Being Colobines, NLs preferred young leaves to



mature leaves, since young leaves usually contain more proteins and less fibre (Diugall & Drysdale, 1964; Struhsaker, 1975; Hladik, 1977; Baranga, 1982). An earlier study on the leaf chemistry of the NL's diet (Oates *et al.*, 1980) showed the preference for mature leaves over young leaves. This difference is mainly due to variation in plant species diversity between the habitats. It has been stated that, where diversity is higher, a large number of species may produce acceptable mature leaves, permitting greater use of those most common items in the forest (Marsh, 1981b).

The second dominant food item in the diet of NLs is seeds. However it was highest only in 4 months, ranking second for 19 months out of 36 months of observations. It has been reported that both *P. rubicunda* and *P. melalohos* (Davis *et al.*, 1988) selected seeds that were highly digestible, while, *C. satanas* (McKey *et al.*, 1981) showed a preference for seeds with high N and CDIG level and low fibre (ADF). This could be the reason that seeds dominate the diet of NLs, next to young leaves. The combination of young leaves and seeds with other food items like young fruit, ripe fruit, flower buds and flowers, in the diet of NLs, was to get a balanced and easily digestible diet with high nutritional value. It is a common strategy among Colobines to meet their nutritional requirements by selecting specific diets (McKey, 1978; McKey *et al.*, 1981; Struhsaker, 1975; Oates *et al.*, 1980).

Conservation Problems

Habitat Destruction at Higher Elevations

Though NLs use different types of habitats like tropical evergreen forests, moist mixed-deciduous forests, plantations and riverine habitats in the lower elevations, the major

ecological niche of the species are the evergreen forests at higher elevations. Since the majority of these NLs populations share their habitat with the Lion-tailed macaques (LTM), the problems identified in terms of habitat fragmentation, timber logging and isolation of populations spelled out for the LTM (in this issue) are fully applicable to the NL populations in the evergreen forests.

Earlier, the cardamom plantations in the rainforests of Tirunelveli Hills had a high proportion of the native species to protect the soil and provide shade for the crops. These plantations also supported good populations of NLs and LTMs. Due to increasing demand for fuel wood, these native tree species have been replaced by fast-growing, and often exotic, species which are no match for native species (Hohmann & Sunderraj, 1990). In addition, illegal timber poaching in the rainforests is common in these areas. This is also a concern in other parts of the distributional range of these species (see LTM article, in this issue).

The NL faces severe pressure from poaching (Mukherjee & Saha, 1974; Daniel & Kannan, 1967; Poirier, 1971; Kurup, 1975; Green & Minkowski, 1977; Krishnan, 1987) because of the belief that certain parts of its body have medicinal value. The langur's flesh and glands are used as food and for preparing a medicine, which is locally known as *Karum Kurangu Rasayanam* used mainly for *Asthuma* (respiratory problem). Some tribes drink fresh and hot blood, which is believed to have rejuvenating powers. Within Wildlife Sanctuaries and National Parks, especially in remote areas some local tribes still use traditional trapping methods for capturing langurs (Hohmann & Sunderraj, 1990).



Habitat Destruction at the Foothills

The NL populations in the buffer areas of Sanctuaries and National Parks, especially in the foothills, are facing anthropogenic problems from the villagers who depend on forest resources to meet their fuel wood demands. Studies on the impact of tree cutting for firewood on the NL foothill population revealed that the tree species preferred by the woodcutters formed the major food resource of NLs. Further, it has been found that, the groups living in highly disturbed areas had a smaller group size, low birth rate and high death rate (Sunderraj & Johnsingh, 2001).

Poaching by local tribes is a problem not only for the NL groups living in the upper reaches of the rainforests, but is also a major threat to the populations outside Protected Areas, particularly in the foothills. The local villagers living near Protected Areas are involved in poaching of NLs. For example, on M-plateau there were two incidences of poaching of 15 animals by the local villagers (personal observation). A survey carried out by our research team in the present Srivilliputtur Grizzled Giant Squirrel Sanctuary, located on the eastern slopes of the South Cardamom Hills, bordering Periyar Tiger Reserve of Kerala, recorded evidence of poaching, fuel wood and timber collection, causing severe damage to the entire region, an ideal habitat for NLs and LTMs.

Lack of Status Information

Even though this species fall under the conservation status of threatened category, there is no recent information available on its population estimates with most status information being outdated and restricted to particular regions. Therefore, its current population status and distribution information throughout its

range is very crucial for the complete understanding of its conservation problem.

Management

Restoration and habitat improvement

- Most of the leasing contracts of cardamom plantations in the interior of Mundanthurai (KMTR) have expired, while some plantations have been abandoned. As these areas are now free from human habitations, restoration of these plantations with native species should be taken up seriously, thereby giving a new lease of life to the NL populations.
- Massive restoration programmes should start in both the government and private-owned cardamom plantations, which are still under lease and where major populations of NLs exist.
- It should be mandatory on the part of both government and private authorities to restore forest areas that are degraded.
- It is necessary to identify fragmented habitats of NLs and create corridors between these fragmented habitat populations to reduce the problems associated with isolated populations, and to improve the habitat quality. Restoration of plantation forests and riverine habitats of foothills, which are under severe anthropogenic pressure from the villages can help the foothill populations of NLs.

Protection

- Strict protection is needed to prevent further extraction of fuel wood by the plantation people and illegal cutting of timber by outsiders.
- Even though NL populations in the higher



elevations show a higher birth rate, in the absence of proper demographic information it is very difficult to predict the existing status. Therefore, the prevailing poaching pressure in the remote areas of the upper reaches should be eliminated.

- Hunting of NLs in the foothills following severe wood cutting pressure could lead to the total elimination of the species from that area. It has been speculated that the Srivilliputtur Reserve Forest once supported good populations of NLs and LTMs. Presently, there are very few NLs and no records of LTMs, largely due to the increasing anthropogenic pressure in these areas.
- Regular patrolling of the buffer areas by the special protection force can reduce the poaching problems.
- Local villagers and tribes can be part of the special protection force and they should be provided incentives or monetary benefits.

Awareness

Intensive awareness programmes among the local villagers to emphasize the conservation significance of this species should be taken up at the earliest.

Population monitoring

- Identification of major NL populations in the entire distributional range (including outside Protected Areas) and their monitoring once every 2 years, by the concerned state forest department is very essential.
- NLs should be included in the list of other endangered species like the Tiger and Elephant, for periodical population census.
- Monitoring and creation of population database would help in the understanding of the population growth in the long run.

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Hoolock Gibbon (*Bunopithecus hoolock*)

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Introduction

The Hoolock gibbon (*Bunopithecus hoolock*), also known as one of the White-Browed gibbons was first described as *Simia hoolock* Harlan (1834) and hails from the Garo Hills in Assam (now in Meghalaya). Among the 9 known species of lesser apes (*Hylobatidae: Hylobates*) from Southeast Asia, the hoolock is the largest gibbon after the siamang (Grooves, 1970; Napier and Napier, 1967). Adults of the hoolock are sexually dichromatic—they undergo a sequence of colour changes from infancy to the sexually dichromatic adults (Peart, 1934; Pocock, 1939; Grooves, 1970; Alfred & Sati, 1990a). While the coat of the adult male is always black, it has prominent white eyebrows and a big genital tuft. The adult female is golden or buff or brownish buff. At birth, hoolocks are pale greyish-white to milky-white and the skin is dark black. Infants above 10 months of age, juveniles, and sub-adults have a black coat colour. Males continue with this coat colour till their adulthood, whereas the coat colour of females changes from black to buff, at puberty. The head and body length of an adult hoolock usually measures 45.7–63.0 cm. The body weight of males varies from 6.1–7.9 kg and of female from 6.0 to 6.6 kg (Shortridge, 1914; Schultz, 1969).

Abstract

The Hoolock gibbon also known as the White-Browed gibbon shows a localized distribution in northeast India (south of the river Brahmaputra), Bangladesh, Myanmar and southern China. It inhabits tropical evergreen forests, is frugivorous, and spends nearly 25–45% of its total activity period feeding. Hoolock gibbons maintain a definite territory, which is defended by loud territorial songs. They live in monogamous family units with deep social bonds, and indulge in social activities like grooming, playing, sun basking. Territorial calls, mother–infant interactions are common in this species, that has a gestation period ranging from 195–210 days.

Distribution and Status

The distribution of the Hoolock gibbon is localized to northeast India, Bangladesh, Myanmar and southern China, between 20° and 28° N, and 99° to 98° E (Fig.1). In India Hoolock gibbons are found throughout south of the river Brahmaputra in the states of Assam, Arunachal Pradesh, Meghalaya, Manipur, Mizoram, Nagaland and Tripura (Tilson, 1979; Mukherjee, 1986; Alfred & Sati, 1986, 1990a, b; Choudhury, 1987, 1988, 1991; Alfred and Sati, 1994).

Ecology

Like other lesser apes, Hoolock gibbons are exclusively arboreal and their suspensory behaviour helps them to use the available habitat. Their light body weight, long and strong arms help them to exploit the terminal branches of the trees and climbers. They inhabit tropical semi-deciduous forests and tropical deciduous forests, which provide them with food, shelter and resting trees. Fig trees (*Ficus* sp.) are very common in these forests and are the main food resources which provide them fruit with leaves, flowers, climbers and insects (Chivers, 1977). They prefer the close canopy three tier forest (high, middle and low) vegetation—the high tier trees support roosting, resting and sun basking while the middle and low tier forests provide food and locomotion trees. (The habitat utilization by the gibbons in the northeastern states of India have been recorded by Mukherjee 1982; Alfred & Sati, 1986, 1990a, b; Choudhury, 1987, 1990, 1991).

Locomotion

Hoolock gibbons move either by brachiation, when the body is turned at right angles with the help of the arms and the body moves forward holding the branches with the left and then the right arm, by leaping or jumping between the trees when the distance is not within reach by brachiation, and by bipedal walking on tree trunks or on the ground or by acrobatic and climbing movements on climbers and tree trunks (Candler 1904). On the ground the Hoolock has a very characteristic gait. The most common position is hanging and sometimes swinging to and fro, referred to as 'the crucifixion pose' (Alfred & Sati, 1986, 1990b).

Fig. 1. Global Distribution of Hoolock Gibbon



Of the total activity period the Hoolock generally spends 15–25% of its time moving either for foraging, feeding, sun basking or resting (Alfred & Sati, 1986, 1990b). Of the total locomotion nearly 70–80% is by brachiation, about 16–25% by jumping, leaping or climbing and about 4–5% by acrobatic or bipedal movement (Alfred & Sati, 1986, 1990b; Islam & Feeroz, 1992).

Territory

Gibbons are arboreal, live in a family unit and maintain a definite territory, which is defended by loud territorial songs (Marler, 1968). Singing announces the occupation of a specific area of the forest by a mated pair and functions as a distance maintaining signal. The territory irrespective of its group size usually varies from 0.15 to 0.35 km² (Tilson, 1979; Alfred & Sati, 1990a; Gittins, 1980; Gittins & Akonda, 1982; Gittins & Tilson, 1984; Islam & Feeroz, 1992). The overlapping zone between the two adjacent groups varies from 0.05 to 0.075 km² (Tilson, 1979), 0.05 to 0.10 km² (Alfred & Sati,



1986, 1990b), and 0.02 km² (Islam & Feeroz, 1992). Aggression and conflicts between the groups take place generally in these areas where they forage for food (Alfred & Sati, 1986; Islam & Feeroz, 1992).

Food and Feeding

The Hoolock, like most of the gibbon species, is frugivorous in nature. Its diet contains fruit, leaves, flowers, tender buds and insects, with mostly ripe fruit, young leaves and infected figs (*Ficus* sp.). Flowers are eaten completely but in some cases only selected parts are consumed. It spends nearly 25–45% time in feeding of the total activity period, which ranges from 120–300 minutes in a day (Alfred & Sati, 1994). Of the total diet intake nearly 51–67% contains fruit, leaves and flowers make up for only 5–23%, while spiders and insects form only 0.1% (Tilson, 1979; Gittins & Tilson, 1984; Islam & Feeroz, 1992; Alfred & Sati, 1994). Fruit diet varies from small berries to wild figs and seasonal fruit like *Mangifera indica* (Mango), *Pierasma javanica* (Guava), *Artocarpus heterophyllus* (Jack fruit), *Citrus reticulate* (Orange) and *Nephelium litchi* (Litchi), besides many other wild varieties. It is seen that a good territory contains 40–45% food supply trees, and of these 6–8% are species of *Ficus benjamina*, *F. bengalensis*, *F. glaberrima*, *F. lepidosa*, *F. nervosa*, *F. pomifera*, *F. geniculata*, and *F. concinna*.

Social Organization

The Hoolock gibbon is monogamous and maintains the social network within the group and social proximity with neighbouring groups of the same species. Hoolock gibbons live in a family system (a mated pair with their offspring). The mean group size (range = 2–6)

was 3.2 for 24 groups and 3.4 for 7 groups observed in Assam by Tilson (1979). Mukherjee (1982, 1986) observed the average group size of 3–3.2 individuals for 6–10 groups in Tripura. Alfred & Sati (1986, 1990b) reported that a family unit consists of a mated pair and 1–3 young ones with an average of 3 individuals (n = 42 groups, ranging from 2 to 5 individuals). Choudhury (1990) recorded the mean size of 3.1 individuals for 8 family groups ranging from 2 to 4 individuals whereas Islam & Feeroz (1992) reported that the group size varies from 2 to 5 individuals in Bangladesh. The age and sex of an individual is determined by the body size, body coat colour, eyebrows and other external characters. Four age categories viz., infant (0–2 years), juvenile (2–4 years), sub-adult (4–7 years) and adult (>7 years) are identifiable (Alfred & Sati, 1990a).

Reproductive Behaviour

In *Hylobates* the gestation period is ca. 210 days (Schultz, 1969), whereas in Hoolock gibbons the recorded gestation period is 195–210 days (Alfred & Sati, 1987). Sexual maturity in both sexes is attained at ca. 7 years of age (Mathews, 1946; Tilson, 1979; Alfred & Sati, 1987). The duration of the menstrual cycle is 27.83 days ranging from 20 to 33 days for 6 cycles (Carpenter, 1941; Mathews, 1946). Generally a single infant is born during winter, with only a single record of birth during the monsoon season (August), which has been related to an incidence of infanticide (Alfred & Sati, 1991).

It has been recorded that mounting usually takes place in the forenoon, the time taken for each mounting bout varying from 10 to 35 seconds and the number of thrusts given by the male partner ranges from 30 to 50 with a



minimum of 3 mounts in a day. The reproductive phase lasts about 2 years, which has been confirmed in the field by 3 successive births from the same pair (Alfred & Sati, 1987).

Mother–Infant Interaction

The mother–infant bond in Hoolocks is very strong, with the mother protecting the infant from other group members and sympatric species. The newly born infant always clings to the mother's belly and feeds on her milk for up to 6 months after which weaning starts. The playing of infants with other group members signals the weaning phase. However, the mature infant, which spends time feeding and playing with other group members, always shares the night bed with its mother till another baby is born.

Play

The young ones of the group spend the maximum time of their total social behaviour in play. Playing varies from mutual (friendly play) to non-mutual (when one of the playing members is not in the playing mood) and avoidance (when one of the playing members avoids playing and the other is interested in playing) playing. Infants and juveniles spend more time playing followed by juveniles, sub-adults and adults. Self-play (when none of the other members are involved in play) is very common in all age categories. In adults, the playful behaviour was more common during the sexual cycle (Alfred & Sati, 1987).

Grooming

Grooming is one of the major activities of social behaviour, with each grooming bout lasting from a few seconds to 90 minutes, which forms nearly 15% of the total activity period (Alfred & Sati, 1986) and may occur between members

of the group. Self-grooming is common, while during the sexual cycle, adult males groom the genital portion of females.

Sun Basking

Sun basking helps gibbons to survive the cold winter conditions (Tilson, 1979; Alfred & Sati, 1986, 1990b). They expose their ventrum to the sun either in a sitting or hanging posture. The average sun basking observed for 92 minutes, ranged from 40 to 235 minutes/day in winter (Tilson, 1979). The average sun basking time in summer was 26 minutes, whereas during the monsoons basking ranged from 10 to 30 minutes/day. During basking the most common behaviour was self-manipulation, grooming and play between the young ones.

Vocalization

Individual Hoolocks vocalize in different forms according to their age and situation. The adults sing and produce loud and elaborated duets to advertise their presence in a particular territory. Duets of this species are of the 'phonetic' type. The frequency pattern and timing of singing behaviour ranges from 4 to 32 minutes and on an average 15 minutes a day (Tilson, 1979; Gittins & Tilson, 1984). Usually the singing was observed in the morning and occasionally in the afternoon. Haimoff (1985) recorded and analysed the acoustical features of the sound produced by a Hoolock in the form of sonograms. About 2–3% of the waking time is spent in its territorial calls, which usually forms 90% of all the vocalizations (Alfred & Sati, 1990b). 'Eek' notes and 'Solo' singing were observed for short durations (Authors' personal observations). The young ones produced a low-pitched 'cuo-cuo' voice during play and whenever they were in difficulty or in trouble.



Infanticide

Infanticide in the wild was first recorded by Alfred & Sati (1991). On the day of the incident of infanticide in a group of Hoolock gibbons, the infant was snatched on the very first day of its birth, manipulated badly by the hands and legs, bitten and dropped to the ground by the adult male. The infant with wounds on its body was observed crying till it became unconscious, but it was not accepted by the group and finally died. The female (mother of the infant) was quiet and did not respond to this unhealthy act of the adult male.

Population Dynamics

The population structure of the Hoolock was given for the first time by Tilson (1979). Of the 7 groups he observed in Assam, the male and female were equal in number (29.2%). On the basis of available habitat in the northeastern region of India, he estimated 78,700 gibbons in 24,640 groups, (2.2 groups/km²). Mukherjee (1982) estimated 1,000–1,400 gibbons in 340–453 groups in Tripura. Gittins & Akonda (1982) observed 4.4 gibbons/km² in Bangladesh whereas Gittins (1984) estimated 1.5 groups/km² and a density of 5.25 individuals/km² in Sylhet, Bangladesh. Recently Alfred and Sati (1994) observed 130 individuals in 42 groups from 32 localities (812 km²) in the Garo Hills.

In the groups of Hoolock gibbons so far observed for population density the male and female sex ratio was 1:1 (Tilson, 1979; Mukherjee, 1986; Alfred & Sati, 1986, 1990a,b, 1994; Islam & Feeroz, 1992), while Choudhury (1990) reported the male ratio to be higher than the female. On an average the number of sub-adults and juveniles was more than that of infants in all the 94 groups for which the population count was carried out.

Conservation and Management

It has been observed that though fragmented patches of forests are still available and habitable for gibbons, only 15–16% of these were inhabited by the Hoolock (Alfred & Sati, 1990a). Those not occupied were patches quite separated from each other by barren hills due to traditional agricultural practices like *jhuming*. It has been recorded that on an average 550 km² of area is affected primarily due to this each year (Hazarika, 1988).

In India continuous deforestation for various purposes has restricted the gibbons population to these fragmented areas (Alfred & Sati, 1990a), while killing and poaching for their flesh by the local tribes has dwindled their populations (Biswas, 1970). In other words, Hoolocks are restricted to the good quality natural forests with a close canopy and minimum human disturbance.

Poaching is a major threat to these primates, as they are considered auspicious and used for their medicinal properties. The Hoolock gibbon can be considered a keystone species, as it helps in the local health of the forest. It has been suggested that while calculating the population/status of the species, it is necessary to be cautious and not extrapolate results based on values from 2–5 forest patches. It, therefore, seems reasonable to base survey reports on home ranges rather than converting them to number/km². To do this we need immediate conservation on a war footing or else we would lose not only the Hoolock gibbon but the entire ecosystem.

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The Meaning of the IUCN Red List Categories and Criteria

CATEGORIES

Critically Endangered (CR)—a taxon is Critically Endangered when it is facing an extremely high risk of extinction in the wild in the immediate future as defined by the criteria.

Endangered (EN)—a taxon is Endangered when it is not Critically Endangered but is facing a very high risk of extinction in the wild in the near future as defined by the criteria.

Vulnerable (VU)—a taxon is Vulnerable when it is not Critically Endangered or Endangered but is facing a high risk of extinction in the wild in the medium-term future as defined by the criteria.

Lower Risk (LR)—a taxon is Low Risk when it has been evaluated and does not qualify for any of the threatened categories, Critically Endangered, Endangered, Vulnerable or Data Deficient. (LRnt—near threatened, LR-lc—least concern, LR-cd—conservation dependent)

Data Deficient (DD)—a taxon is Data Deficient when there is inadequate information to make a direct or indirect assessment of its risk of extinction based on its distribution and/or population status.

Not evaluated (NE)—a taxon is Not Evaluated when it has not yet been assessed against the criteria.

CRITERIA

A—Population reduction—(1) Observed, inferred, suspected or estimated reduction, or (2) Projected or predicted reduction of at least 20% (VU), or 50% (EN), or 80% (CR) in 10 years or 3 generations whichever is longer based on (a) Direct observation; (b) Index of abundance appropriate for the taxon; (c) Decline in areas of occupancy, extent of occurrence and/or quality of habitat; (d) Actual or potential levels of exploitation; (e) Efforts of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites.

B—Restricted distribution—Extent of occurrence estimated to be less than 20,000 sq km (VU), or 5,000 sq km (EN) or 100 sq km (CR) and/or area of occupancy estimated to be less than 2000 sq km (VU), or 5000 sq km (EN), or 10 sq km (CR), and qualifying for any two of the following: (1) Severely fragmented, or known to exist in not more than 10 locations (VU), or 5 locations (EN), or single location (CR); (2) Continuing decline observed, inferred, projected in any (a) Extent of occurrence, (b) Area of occupancy; (c) Area, extent and/or quality of habitat; (d) Number of locations or subpopulations; (e) number of mature individuals; (3) Extreme fluctuation in either (a) Extent of occurrence, (b) Area of occupancy, (c) Number of populations or Subpopulations, (d) Number of mature individuals.

C—Population estimates—Population estimated to number less than 10,000 (VU), or 2,500 (EN), or 250 (CR) mature individuals and either (1) Estimated, continuing decline of at least 10% in 10 years or 3 years or 1 generation whichever is longer (CR) OR in (2) Continuing decline, observed, projected, inferred number of mature individuals and population structure in the form of either (a) Severely fragmented [no subpopulation estimated to contain more than 1000 (VU), or 250 (EN), or 50 (CR) mature individuals]; (d) All individuals are in a single subpopulation.

D—Restricted populations—(1) Population estimated to number less than 1000 (VU), or 250 (EN), or 50 (CR) mature individuals; (2) Population restricted in area of occupancy of less than 100 sq km or less than 5 locations (VU).

E—Probability of extinction—Quantitative analysis showing the probability of extinction in the wild is at least 10% in 100 years (VU), or 20% in 20 years or 5 generations, whichever is longer (EN), or 50% in 10 years or 3 generations, whichever is longer (CR).



Indian Rhesus Macaque: Habitat, Ecology and Activity Patterns of Naturally Occurring Populations

P.K. Seth, P.K. Chopra & S. Seth¹



Introduction

The study of non-human primates is a fascinating and rewarding endeavor, contributing in many ways to our knowledge of human history, behaviour and development. A proper understanding of human evolution is largely based on the knowledge of the evolutionary trends within primates. Each of the living group of primates represents an evolutionary line of development stretching back millions of years. There are two sources of data on human pre-history and evolutionary processes. First, there is a physiological record of the past, studied by archaeologists and paleontologists. Unfortunately, this record does not speak for itself. The concepts used to describe it must come from observations of living species. The second source of information about human evolution is from controlled experiments, which have taught us about genetics and synthetic theory of evolution. Experimental manipulation of both behavioural mechanisms and anatomical complexes illuminate the processes that produced these traits. We can compare closely related species engaged in different activities as well as distantly related species engaged in similar activities.

Almost all orders of mammals are encountered in India. Among the non-human primates are various monkeys, including the Rhesus macaque and the Hanuman langur, both of which are found in forested areas and near human settlements. Lion-tailed macaques, denizens of the Western Ghats, are becoming rare because of poaching. Rhesus macaques (*Macaca mulatta*) (family Cercopithecidae), thrive in a variety of climates and natural environments and are thus widely distributed throughout Eastern Afghanistan, Northeastern China and Indochina, Southeast Asia and the Indian subcontinent. They are partly migratory, sometimes ascending the Himalayas to an altitude of about 2,500 m in summer. Their natural diet consists of fruit, seeds, roots, herbs, and insects. Rhesus monkeys in India thrive in 8 diverse habitats (temple, urban, village, village-cum-pond, pond, roadside, canal sides and forest) having varying degrees of human interactions (Seth *et al.*, 1989).

Rhesus macaques live in troops of 8 to 180 individuals. In recent years, humans have viewed the rhesus monkey as an agricultural pest, largely due to their population explosion (since the export ban in 1978), rapid industri-

¹Adapted from the article of the same title sent to the editor. Due to want of a soft copy of the article, the present communication is an edited and concise form of the original article, without many of the graphs and tables. The original article is available with the authors and the editor.

alization and urbanization leading to a reduction in forest cover and their natural habitat. This has led to their decline in agricultural areas and villages. Nonetheless, the Rhesus macaques are still held sacred in many parts of India by the Hindus and are the object of tolerant affection by Buddhists, with the result that groups have made their homes near human settlements, especially around Buddhist or Hindu temples. Hardly in captivity, Rhesus macaques are intelligent, lively and are likely to be good pets when young but bad-tempered as adults.

Since they are physiologically similar to humans, these macaques have always been the most preferred species in medical and psychological research. Psychological studies carried out have aided in the understanding of infant-mother relationships in humans. The determination of the *Rh* (from rhesus) factor in human blood involves reaction with the blood of this macaque; and it was a Rhesus that was the first primate to be rocketed into the stratosphere.

Age–Sex Classification

Age–sex classification is highly individualistic and varied within a species. A description of development in terms of stages is most important to field workers, for it enables animals to be assigned to age groups by their appearance and behaviour. Different workers have used different age–sex classifications (Box 1).

Behaviour

Though considerable work has been done on the Rhesus, in captivity and in semi-natural conditions, few studies have been done on them in free-ranging conditions. Many lacunae in our knowledge still remain, especially

information regarding roosting sites, foraging routes, home range utilization, time budgeting, habitat, ecology, behavioural correlates, and population dynamics.

The present study has been carried out in various districts in the states of Uttar Pradesh, Haryana, Himachal Pradesh, Rajasthan, Jammu and Kashmir, and the Union Territory of Delhi (Table 1).

Uttar Pradesh and Uttaranchal

Naturally occurring Rhesus groups were studied at 3 locations: Shakumbri Devi (Saharanpur), Karwa Paani (Dehradun) and Loni (Ghaziabad).

Shakumbri Devi: This area is located at the foothills of the Himalayas, a largely hilly area with raos interspersed between the hills. The vegetation of the area is sal (*Shorea robusta*), peepal (*Ficus religiosa*), banyan (*Ficus bengalensis*), mango (*Mangifera indica*), jamun (*Eugenia jambolana*), kikar (*Acacia catachu*), kuri (*Lantana indica*) and kaindu (*Diospyros melanoxylon*). On both sides of the raos are *dharmasalas* (halting places for devotees), temples and some temporary shops. The Rhesus in this area are used to the presence of human beings. The temperature in this region varies from 30–44°C with an average annual rainfall of 120–154 cm. Wildlife like sambars, panthers, elephants, deer, rhesus and langurs are found in this biome. Domestic animals like cows, buffaloes, goats, and dogs are common.



Box 1

Juvenile—Male, Juvenile—Female, Sub-adult Female, Sub-adult Male, Adult Male, Adult Female and Infants

Table 1: Study Areas: Ecology

State & District	Location	Elevation	Temperature & Rain fall	Forest Category
UTTAR PRADESH				
Saharanpur	30°16'N 77°44'E	300–950 m	3°–44°C & 154 cm	Foothills of Siwaliks, dense tropical forest, Gangetic basin.
Dehradun	30°25'N 77°51'E	600–2,000 m	0°–42°C & 180 cm	Foothills of Siwaliks, dense tropical forest, Gangetic basin.
Ghaziabad	28°41'N 72°21'E	210 m	7°–44°C & 80 cm	Flat cultivated
HARYANA				
Hissar	29°02'N 75°58'E	213 m	5°–43°C & 42.57 cm	Flat cultivated
Bhiwani	28°48'N 76°06'E	235 m	5°–43°C & 42.91 cm	Flat cultivated
Jind	29°36'N 76°04'E	210 m	10°–45°C & 65 cm	Flat cultivated
Rohtak	28°53'N 76°38'E	218 m	8°–44°C & 75 cm	Flat cultivated
HIMACHAL PRADESH				
Shimla	31°00'N 77°07'E	610–2,500 m	–4°–27°C & 110.6 cm	Mountainous
Solan	30°44'N 77°09'E	1,462 m	–4°–48°C & 110.6 cm	Mountainous
RAJASTHAN				
Alwar	32°46'N 76°05'E	305 m	8°–48°C & 57.77 cm	Plateau/plants and deserts
JAMMU & KASHMIR				
Jammu	32°46'N 74°53'E	305 m	6.5°–39°C & 107 cm	Mountainous
DELHI				
	28°37'N 77°16'E	200–240 m	3°–45°C & 75 cm	Densely inhabited, mixed terrain

Karwa Paani: Two groups were selected for study, near Karwa Paani, with almost negligible human interaction. The area comprises long stretches of trees running parallel to the Siwalik crest, averaging 5–6 km in width. The forests are owned and managed by the Government of India and are closed to the public. These tropical, moist and deciduous forest areas comprise 6–8% of dry rivers beds (raos) and grasslands. Water runs through these raos

only during the monsoons.

The remaining forest encompasses sal and eucalyptus trees, the former being commercially exploited. Sal is a virtually continuous type. Other vegetation includes kikar (*Acacia arabica*, *A. catachu*), sheesham (*Delbergia sisso*), mango, jamun and kuri. The agriculture crops grown are wheat, rice and maize. Wildlife such as panther, elephant, deer, pig, jackal and fox are found in this area.

Loni: This study area falls in the plains of Uttar Pradesh and is located at a height of 210—above the main sea level. It is a flat cultivated land with a canal running through the fields. On both sides of the canal are long rows of trees such as sheesham, kikar, eucalyptus, peepal and banyan. The agricultural crops grown are wheat, rice, sugarcane, jawar, bajra, barley, oat, maize, brassica and vegetables. The fauna includes buffaloes, snakes, lizards, pigeons

and vultures.

Haryana

Haryana can be divided into two natural areas: sub-Himalayan Terai and the Indo-Gangetic plains. The state has very little forest area, mostly found in the Siwaliks and in the Aravalli, and a few artificially developed forests. The total forest area in the state is 3.7% of the total land, and comprises eucalyptus and acacia.

Most of the canals in the state are newly constructed with eucalyptus trees planted along their sides. Among wildlife, nilgai is found in some districts. The major crops grown in the fields are wheat, rice, maize, jawar, bajra, gram, sugarcane, barley, rapeseed, mustard and cotton. Among the minor crops are massor, mash, linseed, moong, potatoes, groundnut and vegetables.

Hissar: A pond and a roadside group of macaques were observed. The dominant vegetation around the pond is peepal, banyan, kikar, aak (*Calotropis procera*) and hins (*Caparis aphylla*). The agriculture crops grown in the fields are wheat, gram, paddy, jawar, maize and mustard.

Bhiwani: Three groups were studied in this district; 2 just on the outskirts of the Bhiwani city, while the 3rd group, Jeeta Kheri, was about 20 km from Bhiwani on the Hansi Road. The main vegetation is banyan, peepal, kikar, sheesham, eucalyptus, neem (*Azadirachta indica*) and hins. The crops grown are wheat, rice, maize, jawar, bajra, barley, mustard and vegetables.

Jind: A canal side and a pond group of macaques were observed in this district. The pond group is situated outside the village, Safa kheri, 7 km from Narwana on the Delhi road. The other group is about 12 km from Narwana near Kilayat. The vegetation comprised sheesham eucalyptus, kikar, aak and hins, and both areas are surrounded by agriculture fields. The crops grown are wheat, rice, maize, sugarcane, jawar, bajra, barley, mustard, vegetables and pulses.

Rohtak: One roadside and 2 canal side groups were selected for behavioural studies. The canal, trees, ponds, railway line and agriculture fields are the important structures

in the home range of the canal-side groups. The main vegetation is peepal, banyan, kikar, sheesham and aak. Wheat, gram sugarcane, rice, jawar, bajra, mustard, maize, and barley are grown in the fields.

Himachal Pradesh

The state is almost entirely mountainous, with a deeply dissected topography, a complex geological structure and a rich temperate flora of the subtropical latitudes. The average rainfall is ca. 181.6 cm. This state is drained by a number of rivers, the most important of which are Chenab, Ravi, Beas, Sutlej, and Yamuna. All these rivers are snow-fed and hence perennial. The agro-climatic conditions are more suitable for growing a wide variety of fruit and cash crops like seed potatoes, ginger, vegetable seeds, apple and stone fruits. Wheat, maize and rice are the major agriculture crops under cultivation.

Forests cover an area of 21,190 km², which accounts for 39.2% of the total area of the state. Deodar (*Cedrus deodara*), Kail (*Pinus wallichiana*), Chir (*Pinus roxburghii*), spruce (*Picea morinda*), silverfur (*Abies pindrow*), and neoza pine (*Pinus gerardiana*) are the coniferous species, while among the broad-leaved species, sal (*Shorea robusta*), walnut (*Juglans regia*), maple (*Acer saccharum*), horse-chestnut (*Aesculus Hippocastanum*), simal (*Salmalia sp*) and sheesham (*Delbergia sisso*) are found.

Shimla: Two groups were observed in Shimla, one is an urban group on the Shimla ridge at a height of 2,205 m and another at the Jakhoo temple, 2 km from the Shimla ridge, at a height of 2,455 m. The climate is cold, and the dominant structures are houses, shops, hotels, bazaar and trees.



Solan: An urban and a forest group were studied here. Chail, (2,150 m) is a small city (1 km²) with a bazar, houses, bus stand and hotels as the dominant structures, and is surrounded by a thick forest of long deodar (*Cedrus deodara*) trees. Other vegetations found in the area are kail (*Pinus vallichiana*), silverfur, sal, chir, oak (*Quercus incana*, *Q. dilatata*).

Rajasthan

As India's desert state, dominated by the mountains of the Aravalli range and the outlying hills, forests are few and cover about 10% of the total area of the state. These deciduous forests comprise thorny bushes, shrubs and low scanty trees. The study area, Narainiji, is part of a Wildlife Sanctuary, with a small rivulet of sulphur water flowing through it. Vegetation in this zone comprises khejri (*Prosopis specigera*), ber (*Ziziphus jujuba*), aak, peepal and neem. The entire arid forests are surrounded by rocky denuded hills and are the extensions of the Aravalli hills. Wildlife such as tiger, deer, sambhar and nilgai are found in plenty. The major crops under cultivation are wheat, maize, mustard, jawar, bajra, cotton, sugarcane, oil seeds and tobacco.

Jammu and Kashmir

Jammu and Kashmir occupies the northwest tip of India. The state is almost entirely mountainous. The study area of Jammu, the winter capital of the state, is at a height of 305 m. The forest cover is ca. 9.85% of the total area of Jammu & Kashmir. The study area, Bahu fort is on the outskirts of the city, on a hillock on the bank of river Tawi. Inside the fort is a Kali temple and a few neem and peepal trees. Outside the fort are shops selling foodstuff, and hence human interaction

is the greatest with this group, particularly on Tuesdays and Sundays.

Delhi

Delhi (1,483 km²) is a densely populated metropolitan city and consequently supports a negligible amount of natural and artificial forests. The study area comprises an uneven terrain of the outlying hills of the Aravalli range, in front of the Delhi University main gate. The natural vegetation is primarily kikar, peepal, neem, eucalyptus, jamun, grass and shrubs. In addition, there is a wrestling club, a Hanuman temple, and a nursery inside the ridge area.

Material and Methods

Data was collected on 25 naturally occurring Rhesus groups inhabiting temple, urban, pond, roadside, canal-side, and forest habitats, in the states of Uttar Pradesh, Haryana, Himachal Pradesh, Jammu and Kashmir, Rajasthan and the Union Territory of Delhi. Their group size varies from 13–156 animals. These groups were under continuous observations from December 1981 to February 1985. A total of 5,936.5 hours have been spent with these groups. Data on sexual behaviour was collected on the Bahu and Narainiji groups.

The observations were made at half an hour intervals using scan sampling technique, and an average of 25–31 observations were made per day. During observations, the number of individuals engaged in any of the behaviour categories (Box 2) were maintained. Rhesus

Box 2

Drinking, Feeding, Locomotion, Resting, Sleeping, Social Grooming, Agonistic Behaviour, Fear Grimace, Present, Mounting, Sexual Mounting, Self-Play, Social Play, Dominance Display.



Table 2. Activity Day of the Free-Ranging Rhesus in Different Habitats

Habitat	Activity			
	Summer		Winter	
	Start	Stop	Start	Stop
Temple	0500	2000	0700	1800
Urban	0700	1900	0630	1800
Pond	0700	1800	0800	1800
Roadside	0700	1800	0800	1730
Canal side	0700	1900	0630	1800
Forest	0530	1930	0700	1830

macaques were observed for 15 days at a stretch, from dawn to dusk. This involved observations of 11–15 hours during summer and 9.5–11.5 hours during winter depending upon the habitat concerned (Table 2).

Census of all the groups was carried out by visual inspection of the entire area facilitated by the identification of adult/mature members. The total count of the forest groups was carried out while the animals were crossing the road or fire line during group progression. The groups in other habitats were counted while feeding or during group movement to the feeding or sleeping sites. The age and sex of the animals engaged in sexual activity, were also recorded. In addition, the information on courtship and copulation was recorded *ad libitum* during the observation period.

Results

The group size and composition varied from 13–156 animals. Except for the Mohand Rest house group, all the other groups had more than one adult male, with a maximum of 16 adult males recorded in the temple group at Jakhoo. The number of females in a group varied from 6 to 42. Table 3 shows an overall percentage distribution of Rhesus monkeys in different habitats. Sex ratio varies from 2.33 to 3.93. Home range (per 100 animals) is

minimum (0.81 km²) in the pond groups and maximum (6.50 km²) in the forest habitat.

Feeding was the most preferred activity (30.39%) in forest habitat, but was the least observed activity (21.5%) in urban habitats. Similarly, locomotion was recorded to be greatest (22.45%) in the forest habitat and minimum (11.55%) in pond habitats (Table 4). Seasonal differences in activities of the animals in the different habitats also exist (Table 5). In urban habitat, on an average, 38% of the animals were observed resting in winter whereas in summer the percentage of animals engaged in this activity was only 26.30%. During summer, the resting activity was observed to be more in temple (38.30%), followed by canal side (39.10%) and forest (35.40%) habitats than during winter. Locomotion was observed more in canal side groups during winter (20.90%) than in summer (15.40%). In forest habitat, it was 26.60% during summer and 12.60% during winter. Feeding was 38.60% in winter and 22.20% in summer in forest habitat. Animals engaged in grooming, agonistic behaviour and sexual behaviour were significantly more in winter (0.01 > p) than in summer.

Drinking

The free-ranging Rhesus in different habitats except the forests, obtained water from tanks, taps, ponds, flowing drains or canals. Naturally occurring Rhesus populations in forests obtain most of their required daily water by licking dewdrops from leaves during early morning and from water contained in fruit and leaves, which they eat. Sometimes, they also drink water from the tree hollows (accumulated rain water). Drinking was normally observed during the late mornings and in the afternoon, after the resting bout. Rhesus macaques were also observed drinking water from a tank that had



Table 3. Mean Percentage Distribution, Home Range and Sex Ratio of Rhesus in the Different Habitats

Habitat	AM	AF	SAM	ADF	JUV	INF	NB	Sex Ratio	Home Range (km ²)
Temple	9.14	28.57	2.29	4.38	23.62	13.95	19.05	3.13	1.12
Urban	9.27	25.85	2.44	4.39	24.39	15.61	18.05	2.79	1.48
Pond	7.45	27.13	2.13	3.72	23.94	14.89	20.74	3.64	0.81
Roadside	13.64	31.82	2.27	2.27	22.73	15.91	11.36	2.33	0.95
Canal side	8.27	27.82	3.76	4.51	24.81	12.41	18.42	3.36	1.79
Forest	6.33	24.89	2.11	3.80	25.74	18.14	18.99	3.93	6.50

AM: adult male; AF: adult female; SAM: subadult male; ADF: adolescent female; JUV: juvenile; INF: infant; NB: new board

Table 4. Percentage of Animals Engaged in Different Activities in the Various Habitats.

Habitat	Feeding	Locomotion	Resting	Grooming	Play	Agonistic behaviour	Sexual behaviour	Others
Temple	24.70	16.00	34.70	13.63	7.21	1.38	0.54	1.84
Urban	21.50	18.50	34.13	13.52	8.57	1.12	1.18	1.48
Pond	27.52	11.55	35.06	10.80	12.42	1.18	0.45	1.02
Roadside	29.30	13.83	31.93	12.80	10.17	0.57	0.60	0.80
Canal side	26.62	19.55	34.70	7.85	7.62	1.53	0.83	1.30
Forest	30.39	22.45	33.86	4.24	5.95	1.53	0.27	1.29

Table 5. Time Budgeting in Basic Routine Activities in the Various Habitats.

Habitat	Feeding	Locomotion	Resting	Grooming	Play	Others
Temple	26.74	15.75	36.70	12.38	6.20	2.23
Urban	21.92	19.32	36.72	1.78	7.87	2.39
Pond	28.00	11.17	39.35	8.48	11.98	1.02
Roadside	31.26	14.28	34.66	9.80	9.55	0.45
Canal side	25.00	19.84	40.03	5.93	7.10	2.10
Forest	33.60	24.14	35.08	2.15	3.49	1.54

water high in sulphur content, in the temple group (Narainiji, Alwar).

Feeding

The Rhesus is largely vegetarian but occasionally eats insects. Lindburg (1971) noted Rhesus in Dehradun eating termites, grass-

hoppers, ants and beetles. Makwana (1979) observed that in Asarori forest, animal food was eaten more often and regularly. Estrada & Estrada (1977) recorded regular feeding on spiders, land worms, and water snails and occasional hunting of reptiles, birds and mammals by a group of Stump-tailed macaques,

while Malik (1983) has observed Rhesus at Tughlaqabad eating raw eggs.

Infants and juveniles spent more time feeding on terminal twigs than adults of the same group. Sex differences in feeding occur in groups in which the male is considerably heavier than the female. Members of the group generally feed on the same food items at the same time. There are, however, seasonal differences in feeding as the availability of food items varies in different seasons. More animals were observed feeding during winter (38.60%) than in summer (22.20%) in forest habitat. In pond habitats, feeding was more during summer (39.70%) than in winter (26.30%). The seasonal variations in feeding were little in temple, urban, roadside and canal side habitats.

The temple monkeys mostly obtain their food from devotees or tourists visiting the temples. On the other hand, animals in cities plunder houses or shops for their food requirements whereas pond, roadside and canal side animals obtain their food either from local people or they raid nearby fields. The food items include grams, groundnuts, bananas, oranges, apples, carrots, peaches, bread and cooked chapattis. Cash crops like sugarcane, wheat, gram, rice, barley and maize are raided from agricultural fields and vary between seasons. Forest macaques were fully dependent on natural food sources. The availability and concentration of food sources in forests vary in different seasons. During feeding, the dominant male always maintained a distance and when artificial feed was concentrated at a single place, only the dominant male ate first, not allowing the other members to share. Sometimes, one or two females could be seen eating from the same feed, along with the dominant male.

As the dispersal of their roosting sites corre-

sponded to their dispersal during the last feeding hour, resumption of feeding the next day could begin without relocating feeding sites in forest groups. The forest monkeys, on an average, travelled more during the day than did their counterparts in other habitats, while the minimum distance travelled was by the pond groups.

Foraging in various seasons revealed a marked seasonal effect during winter. However, during summer, not only does the feeding tempo increase in the early activity hours, but also when the sun is directly above them, they prefer to eat, if at all, in the shade of the tree or a wall. In contrast, feeding during winter is often intermixed with grooming and basking.

Grooming

Both, the animal grooming and the animal being groomed, were active participants in this activity with each individual assuming specific posture, 'adjusting' its activities to the postures of its partner. Among females, roles were frequently exchanged during grooming. An animal presenting itself for grooming was sometimes ignored, whereas an animal attempting to initiate grooming was seldom rebuffed, while we have also recorded 2 animals simultaneously grooming a third animal. Sometimes chain grooming was also observed, (one animal grooming another and the one who is grooming also being groomed by a third animal). When grooming was disturbed by external factors, for example, approach of a higher ranked animal, the groomer often stopped grooming the earlier animal and was then seen grooming the approaching animal or approached another animal to groom. Rhesus macaques groom mostly during mid day, and the frequency decreases as foraging begins, after the mid day rest. The major



attention during grooming was given to the head, face and dorsal side of the body of an individual. The grooming pattern of females and males were distinct, for instance, females were more involved in grooming than males.

Play

Self-play and social play was observed in Rhesus groups. Self-play is defined in this study as animals swinging or hanging on objects and social play as physical interactions such as wrestling and chasing marked by abrupt cessation and resumption. Play behaviour was observed in the immatures only. Social play was observed more during sunset. The frequency of play differed in various habitats: social play was observed less among forest groups than in other habitats. There were no fixed play partners; social play involved generally 2–4 individuals, mostly infants, newborns and juveniles. There was no sex difference in play behaviour up to 2–3 years of age, after which female juveniles played less than male juveniles. Mature animals were never seen participating in any type of play activities.

Arboreality

Arboreality was recorded maximum in the forest habitat (40.20%), followed by pond (34.10%) and temple (27.84%) habitats. It was lowest in roadside (21.05%) and canal side (21.84%) groups, and also varied within a given habitat, showing a diurnal pattern. In the temple habitat, arboreality was almost the same throughout the day, except morning and evening hours, when the group came down for feeding and foraging. In the urban habitats, the percentage of arboreality was high during early morning and late evening, whereas it was low throughout the day. The diurnal pattern in arboreality in pond and roadside groups differed from the above two. The animals in

these habitats came down from the trees before the sunrise but after the first bout of feeding, again climbed up the trees. During late mornings, the animals came down the trees for feeding and again ascended for mid day resting. Arboreality again decreased in the evening as the animals came down for foraging and feeding. After sunset, the group again moved up the trees, to sleep. Canal side groups spent mid day resting on trees, while in the morning and evening they foraged the ground and raided agriculture fields. On the other hand, forest macaques were only observed on the ground during group movement, spending most of the daytime on trees.

Time Budgeting

An analysis of the activity frequencies and duration in the present study reveals considerable daily and individual variability. The timings of the activities recorded are seasonally and climatically dependent. When habitat and range utilization patterns are viewed in the light of the dietary proclivities, forest Rhesus differ from temple groups. There are, of course, differences in the percentage of time devoted to basic routine activities by monkeys in different habitats (Table 5).

Cluster Analysis

Data reveals a distinct social order in these free-ranging Rhesus populations; the behavioural differences being attributed to the varying habitats. The activity patterns exhibited by Rhesus on the habitat gradient clearly demonstrate the complexity of the dynamics that affect populations. The behavioural profiles of these macaques are dependent upon the ecosystem they occupy and the number and type of activities are age- and sex-dependent. The overall differences between the ecologically



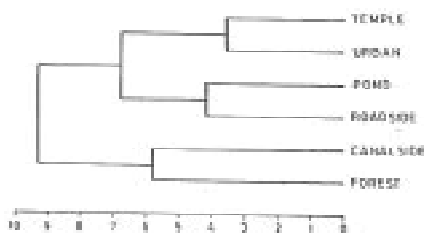
Table 6. Distance Matrices Between Different Habitat Types

	Temple	Urban	Pond	Roadside	Canal side	Forest
Temple	–	3.63009	6.87358	5.66315	5.87116	11.01879
Urban	–	–	7.99030	6.65504	6.13317	11.72992
Pond	–	–	–	4.16017	8.04331	12.30747
Roadside	–	–	–	–	7.44970	11.90217
Canal side	–	–	–	–	–	5.80877
Forest	–	–	–	–	–	–

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different Rhesus groups have been classified according to their ranking order. Computing these qualitative characteristics reveals that though the distance might differ, the ranking order generally remained the same.

The distance matrices between various populations of free-ranging Rhesus were computed based on their behavioural repertoire comprising 8 variables (Table 6). The distance measures between the Rhesus macaques groups inhabiting different ecological niches are summarized in Figure 1. The dendrogram constructed for the free-ranging Rhesus, based on their habitats, reveals 3 clusters. Behaviourally, the temple and urban groups were close to each other. Similarly, pond and roadside groups formed another cluster and the third cluster was of canal side and forest groups. Further, the pond–roadside groups cluster was more closely related to the temple–urban groups cluster than the canal side forest cluster (Figure 1).

**Figure 1. Cluster Analysis of Rhesus Behaviour in Different Habitats**

Discussion

A description of social organization of primate groups requires quantitative measures which permit analysis of significant differences in activities and organization based on variables such as age, sex, taxonomic and environmental influences. The two most prominent diurnal activities of Rhesus monkeys were feeding and resting. Locomotion, social grooming and play among the immatures were the next most important activities of the macaques. The amount of time spent in different activities varied with the seasons. The percentage of Rhesus engaged in feeding in the present study varied from 21.50%–30.39% in different habitats.

Seth & Seth (1986) reported that Rhesus macaques inhabiting temples spent 26.69% of their time feeding while forest-dwelling macaques spent 40.08% of their day feeding. Changes in the habitat, season and human interactions do influence the normal activity of Rhesus macaques affecting the feeding repertoire in particular and relegating other behaviours in the background. Harrison (1985) studied green monkeys activities and reported a significant variation in feeding activity budget over months ranging from 35%–55% whereas in the present study, feeding scores in varying



habitats ranged from 20.10%–39.70% in different seasons.

The variation in time spent feeding in different habitats may be due to the monkey's food preferences. Forest-dwelling Rhesus generally live principally on leaves and fruit of trees such as banyan, fig, mango, tamarind, jamun, sheesham and sal. In contrast, the monkeys in temple, urban, pond, roadside and canal side habitats have developed a taste not only for fruit and vegetables but also for cooked chapattis, bread, roasted grains, peanuts and groundnuts. Kleiber (1975) feels that the time spent in foraging is proportional to their metabolic rate or to their basic energy requirements. The foraging results from the present study clearly indicate the high degree of adaptability of these naturally occurring Rhesus to a variety of food items. The availability of food and the diet of these Rhesus macaques was largely determined by their home range and habitat, which is often restricted by human interactions.

The time spent in grooming activity is more in temple (12.38%) and urban (11.78%) macaques than their forest-dwelling counterparts (2.15%). Bernstein & Mason (1963) observed 24% grooming scores in a captive group of Rhesus monkeys. Lindburg (1971) observed 7.28% grooming scores in free-ranging Rhesus monkeys. The reason for this can be that the social tension is less among forest macaques, while in urban macaques, there is more competition for their existence resulting in greater social tension. In temple habitats interactions with humans are maximum, as tourists and or locals frequently offer them food, though limited in quantity, thus resulting in an increase of aggression leading to social tension in the group. In addition, high population density in temple habitats increases

competition within the groups. Captivity also increases tension among group members, resulting in increased grooming. So the present data supports the hypothesis, postulated by Mason (1964), Poirier (1974), Rahaman & Parthsarathy (1969), that grooming serves to reduce social tension.

Locomotion depends upon the home range size and the distribution of food and water resources within a home range. Forest macaques have to cover more ground to fulfill their daily needs. Moreover, since food and water sources become sparse during summer, locomotion is greater in summer than in winter. On the other hand, pond, roadside, and canal side macaques either get food from villagers or passersby or they raid the agriculture fields, within a radius of 100 m. Moreover, these macaques do not go deep into the fields possibly because of lesser number of trees in case of emergency. Increased locomotion during winter in pond, roadside and canal side habitats is due to the human pressure. Due to ripe agriculture crops, villagers chase them more in winter than in summer, which is the harvesting season. Moreover, the oppressive heat of summer restricts the macaques to cool and shady places.

The diurnal cycle of grooming is remarkably consistent in the Rhesus monkeys across different habitats in the present study. These findings are similar to the ones from other studies on macaques (Simonds, 1965; Bertrand, 1969; Rosenblum *et al.*, 1969; Koyama, 1973).

This documentation of behavioural and social organizational changes in Rhesus monkeys in different biomes provides an insight into the adaptive nature of primate social systems insofar as the influence of the environment, if any, on the social organization and behaviour



of this versatile group of Old World monkeys is concerned. The present investigation clearly suggests that an increase in habitat quality is accompanied by an increase in troop size (for instance, temple groups). On the other hand, the decrease in habitat quality is not always accompanied by a decrease in the troop size or in the home range (for instance, in village groups; Reddy *et al.*, 1986). These findings also support Takasaki's observations on provisioned Japanese troops (Takasaki, 1984). It is intended that the findings of this study would go a long way in understanding the activity patterns, the animal's eco-geography, its socio-ecology, its interactions with other species and its social organization.

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Status, Conservation and Management of Primates in India

Charles H. Southwick & M.F. Siddiqi

Basic Issues of Primate Conservation and Management

Different species of primates in India represent widely different conservation and management problems. Many species, such as the Golden langur (*T. geei*), Phayre's langur (*T. phayrei*), and Lion-tailed macaque, (*M. silenus*) have small populations, limited distributions, and face serious habitat loss. Other species, especially those that are commensal and can capitalize on human habitats, such as Rhesus (*M. mulatta*) and Bonnet's (*M. radiata*), are abundant, widespread in distribution, and are often pests in villages, towns, cities and agricultural areas. In this sense, primate conservation in India involves two ends of the spectrum: (I) rare and endangered

Abstract

India has an exceptionally rich heritage of non-human primate populations totalling 15 species and 39 subspecies. This richness mirrors the biological and environmental diversity of India, ranging from montane habitats in the Himalayas, the deserts of Rajasthan, agricultural plains of the Gangetic basin, subtropical forests of the northeast, mangrove estuaries of coastal India, tropical forests and the coral reefs of South India. Indeed, India has been named as one of Earth's biologically wealthiest nations. This biological and cultural wealth faces tremendous challenges with the current pressures of population and economic development. India is well known, not only for its magnificent biological and cultural heritage, but also as the world's most populous democracy. With over one billion people in less than half the land area of the United States, India's task of maintaining environmental quality is daunting. There is an awareness of conservation and respect for life in both the citizens of India and its government officials, but maintaining this awareness with the increasing demands for economic growth will be a difficult assignment for India's scientists, conservationists, and educators. It will require the best available knowledge, outstanding management skills, and an educational system capable of convincing the people of India of the importance of conservation and wise stewardship of India's biological wealth including primates.

Primates are important components of the Indian biota and its culture. They play a major role in both the natural and the cultural environments, and have contributed to the health and welfare of the entire world by virtue of their role in scientific research. It is vitally important that this important aspect of India's biodiversity be conserved. The present communication will consider conservation issues with regard to endangered primates, and then some of the problems of pest species. This is not intended to be a thorough or comprehensive account but an attempt to provide examples to illustrate the wide range of issues that have to be addressed in Indian primate conservation.



species facing possible extinction and (2) overly abundant species, which can cause agricultural damage, give rise to health and safety issues, or pose general pest problems in local areas. Hence, conservation of primates in India needs to address these different issues and approaches to conservation and management.

Endangered Primates in India

Those species that are primarily forest dwellers and may not adapt readily to human environments face the greatest threat. These threats are common to wildlife throughout the world: habitat loss and hunting. Forest habitats in India as elsewhere in the world, are currently undergoing several types of changes: commercial logging for timber production, clear-cutting for agricultural expansion, conversion to mono-culture plantations of eucalyptus, teak, oil palm or cloves. In all cases, those species which require forest habitats, are lost or threatened. Although, primates and most wildlife species in India enjoy a religious status, their habitat requirements are usually secondary to the pressures of human populations. In India, with human populations increasing at the net rate of approximately 1.4 million people per month, the pressures are severe. Added to these population pressures are regional catastrophes, which add to the environmental pressures, faced by people and wildlife in India.

Another source of wildlife loss in India is hunting. Although primates in India do not face the widespread hunting pressures of those in Africa, Indonesia, or countries of South America, hunting of primates for food is practised by tribal peoples in some localities, like in Northeast India, especially Nagaland and many areas of Arunachal Pradesh.

Two regional examples will illustrate the points mentioned above: (1) Northeast India, and (2) South India. Northeast India is one of the world's most biologically and culturally diverse areas, with great environmental diversity, ranging from the eastern Himalayas to the lowlands of the Brahmaputra valley, extensive subtropical and tropical forests, rich agricultural areas, and coastal zones near the Bay of Bengal. Northeast India represents a fusion of Indo-Chinese, Burmese and southeast Asian, flora and fauna. This region contains 9 species of non-human primates (Rhesus, Assamese, Pig-tailed and Stump-tailed macaques, Capped, Golden and Phayre's langurs, Slow loris, and Hoolock gibbon. This represents 60% of all primates in India, of which, 7 are endangered, 4 of which are critically endangered (Srivastava, 1999). Except for Rhesus macaques, practically all the other primate species have suffered extensive forest loss and some hunting pressures.

The Golden Langur in Northeast India

The geographic range of the Golden langur is confined to a small area of Western Assam and adjacent portions of Bhutan. Two field teams working over the past 5 years in Assam and adjacent provinces of Northeast India have carefully surveyed its complete range in India and have located a little over 1,000 individuals (Mukheerjee, 1998; Srivastava, 1999). The groups are small, averaging 8 to 9 individuals per group, with scattered populations, and their habitats suffer from increasing disturbance. There is an urgent need for greater protection of the forests and wildlife, and more basic research on the habitat requirements of Golden langurs to help insure their survival. Despite field observations on Golden langurs since they were first named and recognized as a



valid species in the 1950s (Gee, 1956), and many subsequent observations (Khajuria, 1961; Mukherjee & Saha, 1974; Mukherjee, 1978, 1994), there is a need for more information on basic ecology and behavioural characteristics, movements and home range patterns, dietary needs, reproduction, recruitment, survivorship, and habitat requirements. Data on these topics are necessary for a scientifically based conservation programme.

Other Primate Species in Northeast India

There are similar problems for the other primate species as well in Northeast India, all of which have suffered habitat losses and many of which are hunted in the hill regions although their geographic distributions are greater than that of the Golden langur. Primate populations in Reserve Areas have suffered serious declines as shown by the recent population trend studies on the Hoolock gibbon in the Gibbon Sanctuary of Hollongapar Reserve Forest (Choudhury, 1999), and the Borajan Forest Reserve (Medhi, 1999), both Wildlife Sanctuaries in eastern Assam. These 2 areas are isolated forest reserves surrounded by tea plantations and cultivated areas. Poaching has not been a major problem, but encroachment of local people results in serious forest degradation, as the villagers have access to the forests for timber cutting, plant and firewood collecting. In Hollongapar Reserve Forest, field surveys from 1987 to 1991 indicated the presence of 15 gibbon groups in 9 km² of forest, with an average group size of 3.3 and a total population of only 130 gibbons (Choudhury, 1999). A repeat survey in 1998 and 1999 in Hollongapar Reserve Forest showed only 10 groups, with an average group size of 3.1, and a total gibbon population of 31. This represents a decline in this gibbon population by 76% in approximately 10 years.

An even more serious picture of primate loss has been observed in the Borajan Reserve Forest in Digboi division of eastern Assam. Systematic field surveys over 4 years from 1995 to 1998 revealed a decline in Hoolock gibbons from 11 groups, totalling 34 individuals in 1995 to only 4 groups totalling 15 individuals in 1998. The number of immature individuals in the 1998 population was only 3, indicating very poor prospects of recruitment and survival for this gibbon population (Medhi, 1999).

Two additional aspects of this decline are alarming: Firstly, 3 other species of primates in Borajan Reserve Forest showed serious decline. Capped langurs declined from 59 individuals in 1995 to 36 in 1998; Assamese macaques declined from 65 to 20, and Rhesus, surprisingly, disappeared entirely. Secondly, this decline in the primates occurred in the absence of primate poaching or hunting, however, there was increased grazing pressure, as domestic elephants were released in the forest to feed on natural vegetation. Human traffic also increased in the forest. All this led to increased disturbance and opening of the canopy. Canopy measurements showed a loss of over 55% of the canopy cover (Mohnot *et al.*, 1999).

These results dramatically show the effects of human population pressures on forest habitats and their drastic consequences suffered by forest-dwelling primates. This emphasizes the urgent need for total protection of Reserve Forests and the wildlife therein. Forest cutting must be controlled and encroachments by people and domestic animals reduced.

Lion-Tailed macaque and Nilgiri Langur in South India

The Lion-tailed macaque (LTM) is one of India's most endangered primates, and its



precarious status was highlighted by Green & Minkowski (1977). Their field surveys in South India estimated a total population of <1,000 individuals, an alarming conclusion about the status of this magnificent primate. In fact, their actual population estimate in 1975 was only 405 individuals based on 4,000 km of field travel in Tamil Nadu, Karnataka, and Kerala from September 1973 to April 1975. As inhabitants of monsoon forests of the Western Ghat mountains, the Lion-tailed macaque's habitat was disappearing rapidly as a result of agricultural expansion and conversion of natural forests to teak, eucalyptus, cardamon, coffee and tea plantations. Lion-tailed macaques were also threatened by hunting, primarily for the pet trade. Outside of Reserve Forests and National Parks, their natural habitats were being reduced to the woody patches in steep narrow ravines, which are usually isolated and scattered, and often could support only single groups averaging 15 individuals. Green & Minkowski (1977) expressed the opinion that the Lion-tailed macaque 'faces imminent extinction, primarily due to habitat destruction'. This conclusion galvanized conservation efforts in South India and helped to secure other forest areas as Reserve Forests.

As a result of conservation, and that the original population estimates of this species were too low, subsequent population figures give a more encouraging picture. Ali (1985) estimated a minimum population of at least 915 animals, and Karanth (1985), undertaking more widespread field surveys in Karnataka, estimated as many as 3,000. More recent surveys and estimates have placed the total numbers in the wild between 3,000 and 4,000 (Singh, 1999).

The Nilgiri langur (*Trachypithecus johnii*) is an obligate dweller of the Western Ghats and

it has received much less attention than the Lion-tailed macaque. In the early 1980s, its population was variously estimated at 5,000 to 15,000, (Wolfheim, 1983), but these were primarily educated guesses. Today, the Nilgiri langur is considered as endangered by the International Union for the Conservation of Nature (Rowe, 1996).

Rhesus and Bonnet Macaques

Rhesus and Bonnets are among the most commensal of non-human primates in India, often thriving in agricultural areas and human habitats: villages, towns, cities, temple sites, and public parks. They live in forest areas, but are most conspicuous in human-dominated environments where they are frequent pests. As such, they are at the opposite end of the conservation spectrum—the problem becomes one of population control of excessive numbers, rather than total protection of declining numbers.

These problems are most clearly demonstrated by population studies of Rhesus monkeys in North India, and this section will focus on data from Uttar Pradesh, especially Aligarh district, an agricultural area in the Gangetic plains 130 km southeast of Delhi. Forty years of population counts of Rhesus macaques in an area of approximately 500 km² showed different stages of population trends (Figure 1). An initial population of 337 monkeys in 17 groups in 1959 increased to 403 in 22 groups by 1962. Then a period of population decline occurred over the next 8 years, which led to a population of only 163 monkeys in 10 groups by 1970 (Southwick, 1989). This was attributed to excessive trapping and export of monkeys for biomedical research, vaccine production, and pharmaceutical testing during the 1960s when the export trade in Rhesus



monkeys from India was often 50,000 juvenile monkeys/year. The age structure of populations showed a conspicuous shortage of juvenile monkeys despite high birth rates. Broader population surveys throughout Uttar Pradesh and adjacent provinces showed even greater population declines of Rhesus in village and roadside habitats (Figure 2). Other factors were probably at work in causing decline in Rhesus population, including high rates of human population growth, and relatively slow increases in agricultural production. We found many villagers with strong feelings against monkeys raiding their crops, and as a result they harassed them, chased them away, and encouraged trappers to remove them, and in a few cases actually killed them.

By the 1970s, the export trade of Rhesus monkeys had declined to less than 20,000 monkeys/year. Rhesus population numbers stabilized and began to show slight increases (Figure 1). In 1978, a total ban on Rhesus export resulted in an increase in their population numbers, since then the Rhesus population of Aligarh district has more than doubled, from less than 250 monkeys to over 500 (Southwick & Siddiqi, 1999). Extensive village and roadside surveys throughout Uttar Pradesh

have shown population increases of several hundred per cent (Southwick & Siddiqi, 1999). In selected areas, such as Tughlaqabad at the southern edge of New Delhi, Rhesus populations increased from less than 100 to over 400 between 1970 and 1988 (Malik, 1989). At Qasimpur, northeast of Aligarh, a translocated group of 20 Rhesus monkeys in 1983 increased to 140 by 1998, a seven-fold increase in 15 years.

The basic cause of such large increases in Rhesus numbers is the high reproductive rates and low mortality rates given adequate food supplies. The Aligarh Rhesus population has consistently shown annual birth rates averaging 80% and annual mortality rates < 30% over 40 years (Southwick & Siddiqi, 1999). In ecological terms, Rhesus are classic 'r' selected animals, capable of rapid population growth and aggressive utilization of commensal habitats. For these reasons, Richard *et al.*, (1989) have named them 'weed macaques,' an appropriate designation in an ecological and behavioural sense.

In agricultural habitats, Rhesus obtain the great majority of their food from crop raiding and from other human sources, including direct handouts from people or thievery from roadside

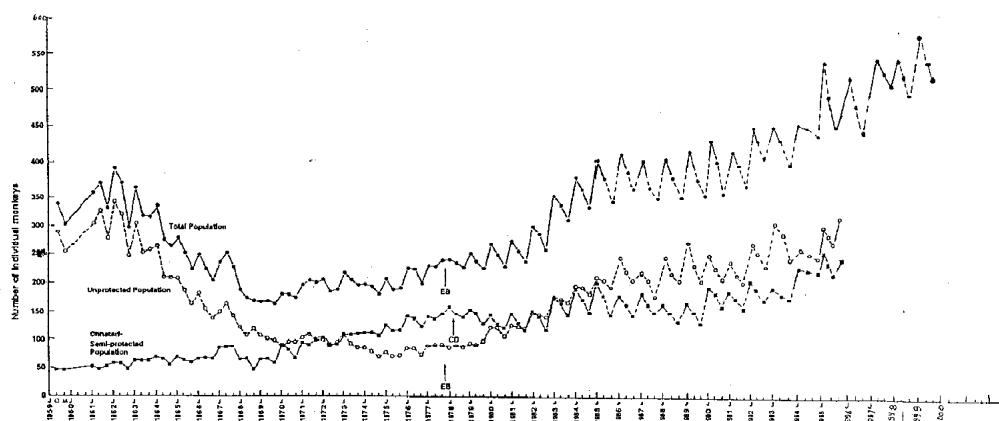


Figure 1. Population changes of Rhesus monkeys in Aligarh District, North India (1959–2000)

Top line = total population; Mid line = unprotected population prior to 1978; Bottom line = Chhatari semi-protected population prior to Chhatari displacement (CD) 1978, EB = Export ban on Rhesus applied in 1978. J = July–August census



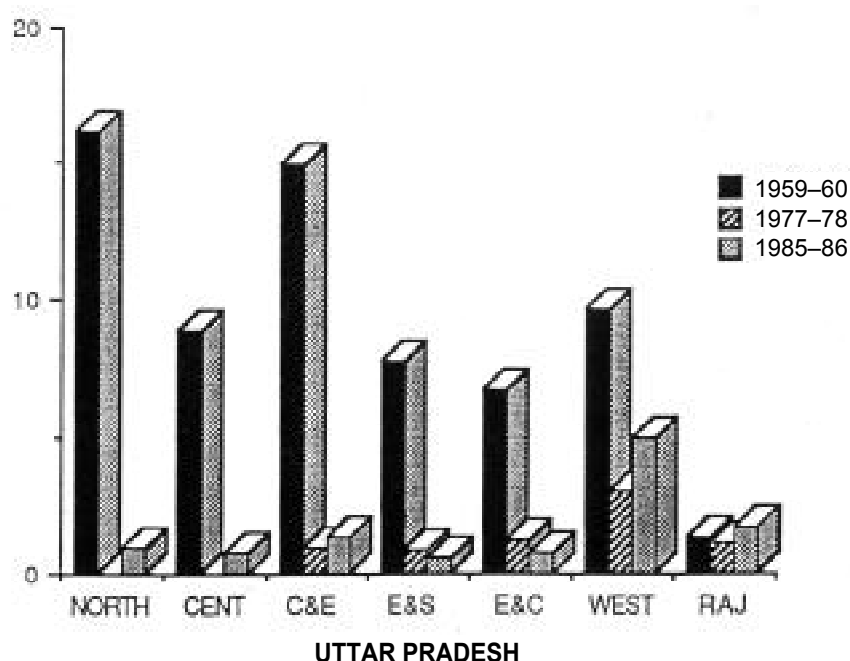


Figure 2. Regional comparisons of Rhesus populations: roadside surveys (1959–1986)

North = northern UP; Cent = Central UP; C&E = Lucknow to Gorakpur, Azamgarh and vicinities; E&S = Azamgarh to Varanasi and vicinities; E&C = Varanasi, Allahabad to Kanpur–Lucknow; E&S; Lucknow to Banda and MP; West = Aligarh to Delhi, Agra and Rajasthan; Raj = Jaipur, Sariska and eastern Rajasthan.

and village shops and bazaars (markets). The latter is especially true in towns and cities, where monkeys in large numbers can also become a public health problem.

Malik & Johnson (1994) have studied an overpopulation of Rhesus macaques in Vrindaban, a Hindu town with many sacred temple sites, near Agra. Monkeys were so abundant in and around the Hindu temples of Vrindaban that the monkeys had harassed 95% of the local people. Monkeys entered houses, stole food, clothing and other goods, uprooted vegetables and garden plants, pulled on electric wires and TV antennae sometimes disrupting service, threatened and attacked people, often causing serious bites. The majority of people held hostile attitudes towards the monkeys and requested authorities to do something about the problem. The situation reached a crisis when a large male monkey lurched aggressively at a small boy on the flat roof of his house, causing the boy to fall to his death.

Dr Malik's surveys (1995–1996) found 1,338 monkeys living in an area of 4.4 km². Group sizes ranged from 14 to 142, with an average of 43 individuals/group. A trapping and translocation programme was undertaken to reduce the population by 50%, and remove monkeys to forest patches and open areas where Rhesus could survive without harassing people or causing crop damage. This programme effectively relieved the immediate problem in Vrindaban, but it is not a long-term solution. It is likely that this population will grow again to higher levels, and those translocated monkey groups may also expand to pest proportions in their new habitats.

Urban Rhesus have also been abundant in Jaipur and have been extensively studied by Mathur and her colleagues (Mathur & Lobo, 1988; Mathur & Manohar, 1999). The old central city of Jaipur had a high population density of 358 Rhesus monkeys/km² (Mathur & Lobo, 1988), even greater than that of

Vrindaban prior to trapping and translocation (3,041/km²). In recent years, however, there has been a natural decline in the Rhesus population in the old central city of Jaipur and apparent movement of monkeys into newer suburbs and parks (Mathur, reported in Mohnot, *et al.*, 1999). Hanuman langurs (*Semnopithecus entellus*), which also exist in Jaipur, have shown a even greater reduction in density from 111/km² to 68/km². Mathur expressed the opinion that the reduction of primate numbers and density in the old city of Jaipur may be due to human crowding, traffic and general 'anthropogenic disturbance'. She and her colleagues felt that translocation is not needed at this time.

Hanuman langurs are also commensal, but rarely reach the pest proportions of Rhesus macaques. They are the true sacred monkeys of India, based on the Hindu epic of *Ramayana*, but all primates in India enjoy a certain religious status among Hindus. Hanuman langurs are the most widespread geographically of all of India's non-human primates, and they live in a very wide range of habitats from montane forests in the Himalayas, to agricultural plains in the Gangetic basin, deserts in Rajasthan, and tropical forests in South India. They not only enjoy a higher level of cultural esteem in India, but they are more elegant and less aggressive than Rhesus, and are seldom considered to be common pests. They are common in some tourist locations such as the Mandore Gardens in Jodhpur, Rajasthan, Akbar's Tomb and Sanctuary near Agra in Uttar Pradesh, and the temples and parks of Mount Abu, Rajasthan. Long-term behavioural and ecological research around Jodhpur by Mohnot and colleagues (Roonwall & Mohnot, 1977; Mohnot, *et al.*, 1999), have shown fluctuating populations, which are relatively more stable than those of Rhesus

macaques. Langur birth rates are generally lower than Rhesus and infant mortality rates are higher. In Mount Abu, Hrdy (1974) found that approximately 50% of all infants died in their first year. Typical mortality rates for infant Rhesus are less than 20%. Nonetheless, the Hanuman langurs of Jodhpur have been increasing in recent years from a population of 1,512 in 1994 to 1,907 in 1999 (Mohnot *et al.*, 1999), an increase of 26% in 5 years. By way of comparison, the Qasimpur Rhesus population (only one group) increased 84% during the same 5 years. Langurs rely more on natural vegetation in most habitat situations and less on crop raiding, and in general, they represent neither the danger nor the economic loss to people characteristic of some Rhesus populations. Crop damages attributable to Rhesus in Shimla and Chamba districts of Himachal Pradesh (S.K. Sahoo reported in Mohnot, *et al.*, 1999) have been found to be unacceptably high, whereas crop damages attributable to langurs were minimal. These findings were based on surveys of 86 crop-land sites, 155 villages and 950 farmers.

Bonnet macaque's have been less studied than Rhesus and langurs, but there are prominent situations where they show some of the undesirable aspects of commensalism typical of Rhesus. This is the case on the Elephanta Island in Bombay Harbour, where the population has increased around the commercial bazaars and tourist areas. They harass tourists and shopkeepers much as Rhesus do. In South India, anecdotal reports indicate Bonnets to be an agricultural pest.

Discussion

India's rich and diverse primate populations present a range of conservation and management problems. At the risk of oversimplification, the problems fall into two main



categories, each with its particular needs and solutions: (1) rare and endangered species, some on the verge of extinction, and (2) overly abundant species which become pests in some situations. More than half of India's primate species are rare and endangered, facing serious habitat disturbances and losses, and sometimes subject to hunting. These are the Golden langur, Phayre's and Capped langur, Pig-tailed and Stump-tailed macaque, and Hoolock gibbon. These species need total protection and habitat improvement.

At the opposite extreme, one or two species are locally overabundant, posing pest problems in terms of agriculture and public health. These are Rhesus and in some instances, Bonnet macaques. Here different management approaches must be used, including reduction in supplemental feeding, translocation from trouble areas, and fertility control if new and reasonable methods can be developed. Translocation is a temporary solution; fertility control may be a long-term solution but this requires research and development of new methods of birth control in pest animals, that are practical, economically feasible, and humane.

Between these extremes, several gradations occur. Hanuman langurs are neither endangered nor do they pose pest problems in most cases. They are highly revered by the people of India, and in most cases they live in reasonable balance with their local environments. Also Nilgiri langurs in South India and Assamese macaques in Northeast India are somewhat intermediate between the two extremes listed above. In many cases they are not seriously endangered (although this may be questioned and more data may reveal that they are indeed threatened), nor are they significant pests to agriculture or human health.

Still a fourth type of situation is that in which we know so little about true abundance and ecology that it is difficult to classify the nature of conservation issues. This is true of India's two prosimian species, the Slow and Slender loris. Both are nocturnal and secretive, and only recently have field studies been undertaken to determine some facts about their population status and habitat relations (Singh, 1999; Srivastava, 1999).

Of the situations listed above, certainly the most urgent are the conservation problems of rare and endangered species. These have been known for the Lion-tailed macaque for at least 20 years, and substantial efforts, both scientific and political, have gone into Lion-tailed macaque conservation. The response has been international, with scientists and conservationists of many nations studying the problems of habitat protection and expansion, ecological and behavioural studies of natural populations, and more careful management of captive populations with a view towards increasing reproduction and insuring genetic quality.

Much less effort has gone into the endangered species of Northeast India, virtually all of which are threatened and endangered. The most critical of these is the Golden langur, facing critical habitat loss in Assam, and highly endangered by virtue of its small numbers, small group sizes, scattered populations, and very limited geographic range. Similar problems in India exist for the Hoolock gibbon, Phayre's and Capped langur, Pig-tailed, and Stump-tailed macaques. These species are endangered in India but they have broader ranges throughout Southeast Asia, and are hence not endangered. Golden langurs also occur in Bhutan, but their total geographic range still remains quite limited.



For these highly endangered species in India, two approaches can be pursued at the present time. In the first case, they require immediate conservation attention: total protection and enforcement of all local statutes protecting them and their habitats. The second major need for these endangered species is more field research to provide accurate data on habitat requirements and population ecology. Such information is essential to design and administer the most effective conservation and management programmes. A few examples of the types of data needed have been obtained in recent years, represented by the work of the Indo-US Primate Project (Mohnot, *et al.*, 1999; Srivastava, 1999), and the earlier studies of several leading primatologists in India, including Drs Alfred (1992), Gupta (1996), and Mukherjee *et al.*, (1998). Their field studies are exemplary of the types of scientific information that are needed. Effective conservation programmes require sound knowledge of the species and its habitats and knowledge of economic, social and political factors pertaining to the region. Conservation efforts must involve the local communities and regional environmental NGOs as well as field biologists and government officials. Community based and regional conservation efforts can be successful, and they represent our best hopes for the survival of wildlife habitats and endangered species. Some focus can be directed toward individual species, but emphasis must also be placed on the entire spectrum of biodiversity.

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Primates in Northeast India: An Overview of their Distribution and Conservation Status

Anwaruddin Choudhury



Introduction

Northeast India comprising the states of Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, and Tripura (21°58'–29°27' N, 89°42'–97°24' E) has the highest primate diversity in India. Nine species have so far been recorded while another 3 reported need confirmation. Although, the distribution range of these species has remained almost the same, expansion of human habitation, destruction of habitat for agriculture including *jhum* cultivation, and poaching have resulted in a sharp decline in the populations, besides severely fragmenting their habitat. Developing a long-term strategy for primate conservation is of utmost importance, given the rapid loss of habitat and poaching. Due to fragmentation, a number of small and isolated populations are formed and only parts of this population are protected under the Protected Area network. The northeast has a tropical monsoon climate with a hot and wet summer and a cool and usually dry winter. The average temperature ranges from less than 4° (average minimum, December to early February) to 30°C (average maximum, June to August) (range: 0° to above 38°C). The annual rainfall ranges from less than 1,000 mm in parts of central Assam to more than 10,000 mm in parts of the southern face of the Meghalaya

Abstract

Northeast India has the highest diversity of primates in India, with 9 confirmed species records and 3 other species whose sightings need confirmation. Although, the general range of primates has remained almost the same, expansion of human habitation, destruction of habitat, and poaching has resulted in the sharp decline of their populations, besides severely fragmenting their habitat. For conservation of these species, many of which are globally endangered, developing long-term strategy is of utmost importance. Although, a majority of the population is protected in the various Parks and Sanctuaries, the coverage is still inadequate.

plateau and the foot of the Mishmi Hills. 75% of the rainfall is from the monsoon (May to September), while winter rains are not uncommon. The higher areas of the Eastern Himalayas, Mishmi Hills and the Saramati Peak experience snowfall in winter.

Historical information on primate distribution are found in Branford (1888–91), Ellerman & Morrison-Scott (1951), Finn (1929), McCann (1933a, b, c, 1942), Pocock (1928, 1931, 1939) and Wroughton (1916). Valuable information is also found in other studies (Choudhury, 1986, 1990b, 1993, 1998a;

Corbet & Hill, 1992; Gee, 1964; Napier & Napier, 1967; Prater, 1948; Roonwal & Mohnot, 1977; Tikader, 1983). Noteworthy works on the Golden langur included Gee (1956, 1961), Khajuria (1956, 1962b), Mukherjee (1978), Oboussier & Maydell (1959, 1960) and Choudhury (1992a). On the Capped langur, there are Khajuria (1962a), and Choudhury (1989b). Phayre's langur had been studied in Tripura (Mukherjee, 1982; Gupta & Kumar, 1994; Gupta, 1998) and in southern Assam (Choudhury, 1988c, 1990b). Hoolock gibbons had been studied in Assam (Tilson, 1979; Choudhury, 1991; Kakati, 1998), Arunachal Pradesh (Mukherjee *et al.*, 1988) and Meghalaya (Alfred, 1992; Alfred & Sati, 1990). The Slow loris has been virtually untouched save for a regional review (Choudhury, 1992b).

State-wise works covering primates in general were carried out in Arunachal Pradesh (Choudhury, 2001), Assam (Choudhury 1989c, 1997a), Manipur (Choudhury, 1989a) Meghalaya (Choudhury, 1998b), Mizoram (Mishra *et al.*, 1994) and Tripura (Gupta, 1994). Recently the distribution of primates in Assam and Arunachal Pradesh has been mapped (Choudhury, 2001). In this article, species accounts of the primates recorded from the northeast forest of India are reported.

Slow Loris (*Nycticebus coucang*)

Distributed in all the northeast states, on both banks of the Brahmaputra river, it is scarce in the northern bank, and occurs from the floodplains (Dibru-Saikhowa National Park, Assam) to the mountains (Mehao Sanctuary, Arunachal Pradesh). Recorded up to 2,400 m in eastern Arunachal Pradesh, this species prefers dense evergreen forests. The distribution of this species in the region has been

mapped by Choudhury (1992b). Recorded in at least 43 Protected Areas of the region, its presence has been doubted in 2 others (Table 1).

Pig-tailed Macaque (*Macaca nemestrina*)

Its distribution was imperfectly known and vaguely referred to as 'eastern India (probably some districts east of the Ganges)' (Pocock, 1939), and 'Assam' (Roonwal & Mohnot, 1977). Presently it is restricted to the south bank of the Brahmaputra river, and occurs in all the northeast states (Choudhury, 1989c). Overall scarce, but locally common in Garampani, and Bherjan–Borajan–Podumoni Sanctuaries, the species occurs from the floodplains (Dibru-Saikhowa National Park) to more than 2,000 m in Mishmi Hills, preferring dense evergreen and semi-evergreen forests. Recorded in at least 24 Protected Areas of the region, it possibly occurs in 9 more (Table 1).

Assamese Macaque (*M. assamensis*)

Distributed in all the northeast states, on both banks of the Brahmaputra river, it is the most abundant primate in the mountains of Arunachal Pradesh. This species occurs from the floodplains (Dibru-Saikhowa National Park) to the high mountains (Dibang Sanctuary, Arunachal Pradesh), up to 2,800 m (rarely to 3,000 m, especially in summer) in Arunachal Pradesh, and prefers dense forests. Recorded in at least 41 Protected Areas of the region, its presence has been doubted in 4 others (Table 1).

Père David's or Tibetan Macaque (*M. thibetana*)

This species was sighted in West Kameng district of Arunachal Pradesh (Choudhury, 1998c), recorded from 1,900 m to 2,700 m in



temperate broadleaf forests. Fieldwork is necessary to confirm the presence of this species, as the nearest known locality is at least 1,000 km away in South-Central China. It does not seem to belong to either of the known races of the Assamese macaque, however, it is also likely that this could be a new subspecies of *M. assamensis*.

Rhesus Macaque (*M. mulatta*)

Recorded in all the northeast states, on both banks of the Brahmaputra river, it is common in Assam. In Arunachal Pradesh, this species is mostly confined to the foothills and adjacent plains, it occurs from the floodplains to about 2,000 m. Found in dense forests, light woodlands as well as near human habitations, it has been recorded in at least 43 Protected Areas of the region while it is likely to occur in 10 more (Table 1).

Stump-tailed Macaque (*M. arctoides*)

Like *M. nemestrina*, its distribution is restricted to the south bank of the Brahmaputra river (Choudhury, 1988a). It is very scarce all over its range in northeastern India, occurs in the foothills, hills and mountains and there are records from plains too (Gibbon Sanctuary, Assam), up to above 2,000 m. This species prefers dense evergreen forests and has been reported in about 24 Protected Areas of the region while its presence has been doubted in 7 others. The Barail Range in Assam is a key area for the species and it is relatively common in the mountains of Nagaland, Manipur and eastern Mizoram (Table 1).

Hanuman or Common Langur (*Semnopithecus entellus*)

The easternmost limit in India is the Rydak river in north Bengal (Choudhury, 1997), and

all earlier reports of this species in the northeast (Chatterjee, 1989; Corbet & Hill, 1992; Kaul, 1999; Khatri, 1995) appeared to be a misidentification of the Capped langur.

Phayre's Langur (*Trachypithecus phayrei*)

Restricted to the southern areas in Tripura, Barak Valley districts of Assam and Mizoram, the species is scarce but locally common at many places. It occurs till an elevation of 1,000 m. It prefers evergreen and semi-evergreen forests but is well at home in bamboo brakes and light woodlands. It has been recorded in 5 Protected Areas of the region while it is likely to be present in 6 more (Table 1).

Capped Langur (*T. pileatus*)

Distributed in all the northeast states, on both banks of the Brahmaputra river, it is absent west of the Manas river where *T. geei* occurs, and also between the Siang and the Dibang rivers. This is the most common langur in the region, occurring from the floodplains (Kaziranga National Park) to about 2,800 m in the Eastern Himalayas. Found in dense forests as well as in light woodlands, it has been recorded in at least 43 Protected Areas of the region while its presence has been doubted in 4 others (Table 1).

Golden Langur (*T. geei*)

This species is restricted to the western areas in three districts of Assam, while the rivers Brahmaputra, Manas and Sankosh form the southern, eastern and western limits of its distribution. It is overall scarce but locally common at places, and prefers dense as well as light forests. It has been recorded in 2 Protected Areas of western Assam (Table 1).



Hoolock Gibbon (*Bunopithecus hoolock*)

Like *Macaca arctoides* and *M. nemestrina*, its distribution is restricted to the south bank of the Brahmaputra and east bank of the Dibang river. It has become rare all over its range although it is still widely distributed and locally common in some areas. It occurs from the floodplains to the mountains, and has been recorded up to 2,500 m in Manipur. This species prefers dense evergreen and semi-evergreen forests. Found in about 30 protected areas of the region, its presence has been doubted in 3 others (Table 1). In Tinsukia district of eastern Assam, this species has been recorded in some village woodlands.

Conservation Problems

Habitat destruction

Habitat destruction by logging, encroachment, *jhum* (slash-and-burn shifting cultivation practised by the hill tribes), and monoculture forest plantation is a major threat to the survival of the primates, which they share in general with all other forest-dwelling, especially arboreal animals. The forest cover in Northeast India is disappearing at an alarming rate, with more than 1,000 km² of forest destroyed annually in 1970s and 1980s (data from the National Remote Sensing Agency, Hyderabad). This is further exhibited in states like Meghalaya where the forest cover has declined from 33.1% in 1980–82 (National Remote Sensing Agency, Hyderabad) to 18% in 1993 (FSI, 1997) and in Arunachal Pradesh, where between 1989–90 and 1991–92, 334 km² of dense forest has been lost (FSI, 1993, 1995). Since most of the primates are forest-dwellers, their survival depends upon the continued existence of the forest cover.

Encroachment is also a problem in the reserved forests. In the Balipara RF of Sonitpur

district, Assam, a good area for the Capped langur, more than 100 out of 188 km² is under encroachment and forest villages, while about a third of Golden langur habitat was lost due to felling and encroachment in 1990's. Almost the entire population of primates (Slow loris, Pig-tailed macaque, Assamese macaque, Rhesus macaque, Stump-tailed macaque, Capped langur and Hoolock gibbon have vanished from the 900 km² rainforest tract comprising Nambor (south block), Diphu, and Rengma RFs in Golaghat district (Assam) because of border problem with Nagaland and subsequent felling, poaching and encroachment, between 1970s and 1980s.

In the hilly areas throughout the northeast, *jhum* cultivation is an important factor of forest destruction. As seen in Manipur with a total area of 22,327 km², *jhum* currently covers more than 1,800 km² (8.2%) of the total area. Even in the hilly areas of Assam, the area under current *jhum* is more than 2,600 km². The destruction of forest is not only reducing the habitat and number of primates but also results in fragmentation, and species such as the Slow loris and Hoolock gibbon suffer most due to this.

Poaching

Killing primates for their meat is a serious threat in parts of Assam (mainly North Cachar Hills, parts of Cachar, Assam–Nagaland border, and Assam–Mizoram border areas), central and eastern Arunachal Pradesh, parts of Meghalaya and Tripura, hill districts of Manipur, and entire Nagaland and Mizoram. Tribes such as the Nagas, Kukis (including Hmar, Paite, Biata), Mizos, Chakmas, Tipperas, Adis, and Nishis (formerly Dafflas), relish primate meat and regularly hunt them. Tangsas, Garos, Khasis, Lais (Pawis), Maras (Lakhers) and Reangs also kill primates for food.



Other problems

Unscientific harvesting of bamboo for large paper mills (at Jagiroad, Panchgram, and Jogighopa in Assam, and Tuli in Nagaland), and oil mining and exploration (eastern Assam and adjacent areas of Arunachal Pradesh), open-cast coal mining (eastern Assam and parts of Meghalaya) are some of the other conservation problems which are not only destroying the habitat but are also causing pollution and disturbance. Depredation in the crop fields, vegetable gardens and orchards by the Rhesus macaque is a serious problem in parts of Assam. Villagers often invite hunters, especially Nagas to shoot the monkeys (Choudhury, 1988b). The Assamese macaques also raid crops, especially in *jhum* areas. There are occasional reports of other species such as the Pig-tailed macaque (near Borajan RF, Assam) and Stump-tailed macaque (near Dampa Rengpui in Mizoram, also in the Garo and Khasi Hills) coming to the fields. There is at least one record of the Capped langur visiting crop fields and orchards in a disturbed habitat (near Gharmura in Innerline RF, Hailakandi district).

Conservation Measures Taken

Legal protection

Many species are protected under Schedule I (*Nycticebus coucang*, *Trachypithecus phayrei*, *T. pileatus*, *T. geei*, *Bunopithecus hoolock*) and Part I of Schedule II (*Macaca nemestrina*, *M. assamensis*, *M. mulatta*, *M. arctoides*, *Semnopithecus entellus*) of the Wildlife (Protection) Act 1971, which prohibits their killing or capture dead or alive. However, enforcement in the field is virtually nonexistent except in the Protected Areas. Most locals are also unaware of such legal status.

Habitat protection

Forty-nine notified Protected Areas in the region have primate populations, the diversity ranging from a single species (Orang National Park, Assam) to 8 species (Dampa Sanctuary, Mizoram). However, the cover of the PA network is very insignificant, accounting for only 5.8% of the total geographical area of the region.

Discussion

The northeast region has the richest primate diversity in India, largely due to its location in the transitional zone between the Indian and Indo–Chinese sub-regions. The pattern of distribution of different species and the role of rivers, both large (Brahmaputra and Dibang) and small (Sankosh, Manas and Barak) as zoogeographic barriers in dispersal is intriguing. Except for the Golden langur and Phayre's langur, all other species have a large extent of occurrence in the region. The Rhesus macaque, Capped langur and the Assamese macaque are the most abundant species. Among the doubtful species, the occurrence of the Hanuman langur could be ruled out but that of the Silvered leaf monkey and Père David's macaque (*M. thibetana*) need further investigation. Most primate populations are declining due to rapid loss of habitat (resulting in net loss and fragmentation) and poaching. The ban on logging imposed by the Supreme Court of India has greatly checked deforestation but once it is allowed, maybe on the basis of working plans, it will be disastrous as implementation of the prescriptions of the plan in the remote areas is virtually impossible.

Although most tribal communities hunt primates for food, there are some local taboos, which have helped in the conservation of some



species in many areas. The *Mishmis* do not hunt the Hoolock gibbon, and consequently it is common in Lohit and Dibang Valley districts. Most of the tribes do not like to take the meat of the Slow loris and hence, it is not pursued.

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Table 1. Protected areas in northeast India with primate species (confirmed presence*; presence doubtful –)

Name of PA	Slow loris	Pig-tailed macaque	Assamese macaque	Rhesus macaque	Stump-tailed macaque	Phayre's langur	Capped langur	Golden langur	Hoolock gibbon
ASSAM									
Barnadi WS	*		*	*			*		
Bherjan-Borajan-Podumoni WS	*	*	*	*	Extinct		*		*
Burhachapori WS				*			—		
Chakrashila WS		—	*			*			
Dibru-Saikhowa NP	*	*	*	*			*		*
East Karbi Anglong WS	*	*	*	*	*		*		*
Garampani WS	*	*	*	*	*		*		*
Gibbon WS		*	*	*	*	*	*	*	
Kaziranga NP	*	—	*	*		*		*	
Karbi Anglong WS	*	*	*	*	*		*		*
Laokhowa WS				*			*		
Manas NP	*		*	*			*	*	
Nambor WS	*	*	*	*	*		*		*
Nameri NP	*		*	*			*		
Orang NP				*					
Pabitora WS				*					
Pani-Dihing BS				*					
Sonai-Rupai WS	*		*	*			*		
ARUNACHAL PRADESH									
D'Ering Memorial WS				*					
Dibang WS	—	—	*	—	—		*		—
Eaglenest WS	*		*	*			*		
Itanagar WS	*		*	*			*		
Kamlang WS	*	*	*	—	*		*		*
Kane WS		*		*	*			*	
Mehao WS	*	*	*	*	—		*		*
Mounting NP	*		*	—			*		
Namdapha NP	*	*	*	—	*		*		—
Pakhui WS	*		*	*			*		



Name of PA	Slow loris	Pig-tailed macaque	Assamese macaque	Rhesus macaque	Stump-tailed macaque	Phayre's langur	Capped langur	Golden langur	Hoolock gibbon
Sessa Orchid WS	*		*	*			*		
Taley Valley WS	*		*	—			*		
MANIPUR									
Bunning WS	*	—	*	*	*		*		—
Jiri-makru WS	*	*	*	*	*		*		*
Keilam Hill WS	*	*	*	*	*	—	*		*
Yangoupokpi-Lockchao WS	*	*	*	*	*		*		*
Zeiad WS	*	—	*	—	*		*		*
MEGHALAYA									
Balpakram NP	*	*	*	*	*		*		*
Nokrek NP	*	*	*	*	*		*		*
Nongkhyllem WS	*	*	*	*	*		*		*
Siju WS	*	*	*	*	*		*		*
MIZORAM									
Dama WS	*	*	*	*	*	*	*		*
Khawnglung WS	*	—	*	*	—	—	*		*
Lengtend WS	*	—	*	—	*	—	*		*
Murlen NP	*	—	*	—	*	—	*		*
Ngengpui WS	*	*	*	*	*	*	*		*
Phawngpi NP	*	*	*	*	*	—	*		*
NAGALAND									
Fakim WS	*	—	*	—	—		—		—
Intanki WS	*	*	*	*	*		*		*
Pulie-Badge WS	*	—	*	—	—		—		—
Rangaahar WS	—	Extinct	Extinct	*	Extinct		Extinct		Extinct
TRIPURA									
Gumti WS	*	*	—	*	*	*	*		*
Rowa WS	Extinct	Extinct	Extinct	*	Extinct	—	—		Extinct
Sepahijala WS	*	*	—	*	—	*	*		*
Trishna WS	*	*	—	*		*	*		*



Distribution, Conservation Status and Priorities for Primates in Northeast India

A. Srivastava & S. M. Mohnot



Introduction

Tropical rainforests, which cover about 6% of the land surface, harbour more than 50% of all living species of the world (Marsh & Mittermeier, 1987, McNeely *et al.*, 1990). Loss of species due to fragmentation in isolated remnant forests is a serious threat to the survival of taxa. Of the two biodiversity 'hotspots' in India, the Eastern Himalayas (i.e. Northeast India) is in greater danger than the Western Ghats (Anon., 1997). Northeast India is the biogeographical gateway to India's richest biodiversity zone and is unique for its genetic resources (Srivastava, 1999). In spite of the variety of primates found in this region, there has been virtually no effort to study primates in this belt until recently. Gee (1956) and Khajuria (1956), reported a new species of langur in Assam. Preliminary surveys were also carried out by the Zoological Survey of India, Forest Department, Wildlife Institute of India and different universities from time to time (Mukherjee & Saha, 1974; Mukherjee, 1982; Alferd & Sati, 1990; Gupta, 1994).

Northeast India comprises 7 states (Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, and Tripura) with a total geographical area of 255,083 km², of which 164,043km² is forested. These forests are

Abstract

The research team of the Indo-US primate project undertook extensive surveys using line transect method, covering 6,50,956 ha. forest areas in some parts of NE India between 1994 and 1999 to obtain information on the status and distribution, to record the fragmentation of primate habitat and to develop eco-ethological profiles of non-human primate species. Nine species of non-human primates namely the Hoolock gibbon (*Bunopithecus hoolock*), Golden langur (*Trachypithecus geei*), Capped langur (*T. pileatus*), Phayre's langur (*T. phayrei*), Stump-tailed macaque (*Macaca arctoides*), Assamese macaque (*M. assamensis*), Pig-tailed macaque (*M. nemestrina*), Rhesus macaque (*M. mulatta*), and Slow Loris (*Nycticebus coucang*) were encountered. As per the IUCN criteria 4 species qualify as critically endangered, 3 as endangered, and one each in the rare and data deficient category. Demographic trends, isolated distribution and shrinking habitats indicate a decline in primate populations in Northeast India. Based on the surveys the revision of 1996 IUCN Red Data list of Threatened Animals and the Wildlife (Protection) Act, 1992 is proposed besides other recommendations.

composed of evergreen rainforest, semi-evergreen, and moist deciduous forests. Much of this stretch comprises (34%) protected reserved forests, (9.2%) protected

forests, Wildlife Sanctuaries, and National Parks, and (56.8%) unclassified areas. According to the National Remote Sensing Agency, the actual forest cover is now declining and is in the process of degradation (Anon., 1997) because of illegal felling, encroachment and resulting soil erosion. A combination of habitat destruction, hunting, and live capture of species have also driven several primate species to the brink of extinction in varying degrees.

In 1994, the authors developed an integrated, collaborative Indo-US Primate Project to conduct systematic status surveys, record fragmentation of primate habitats, and develop eco-ethological profiles of individual primate species to provide a basis for the conservation and management of primate habitats and species therein.

Between 1994 and 1999, our research team surveyed over 6,50,956 ha of protected, unprotected, and unclassified forests using line transect method which was modified to cover all representative areas randomly in a stratified manner (Burnham *et al.*, 1980, Anon., 1981, Kent & Coker, 1994). Many long-term species-specific research on the ecology and behaviour were also conducted to understand the plasticity in behaviour, responses to habitat change and long-term consequences of these changes on the future of primate populations. Detailed analyses of the results are beyond the scope of this article and are reported elsewhere. However, information on the status, distribution and conservation of the species confined to Northeast India is given below.

Distribution and Conservation Status

Slow loris (*Nycticebus coucang*)

Slow loris inhabits all the northeast states, with the northwestern limit of its range being the

southward bend of the river Brahmaputra at about 26°N, 90°E (Srivastava, 1999). Their preferred habitats are tropical and subtropical evergreen and semi-evergreen rainforests with continuous dense canopies. They also prefer forest edges, which have a higher density of insect prey (Rowe, 1996). Slow loris populations have been declining and its status throughout its distribution range is not known (Wolfheim, 1983; Srivastava, 1999). The numbers are very small and the limited survey conducted by the Indo-US Primate Project between 1994 and 1999 indicated their presence in few isolated pockets only. The Slow loris is listed under Schedule I of the Wildlife (Protection) Act, 1972. IUCN SSC Red Data Book listed this species as '*Data Deficient*'.

Stump-tailed macaque (*Macaca arctoides*)

The Stump-tailed macaque inhabits all the 7 states of northeast India from the sea level to an altitude of 2,400 m. The northwest limit of its range is the south of the river Brahmaputra inhabiting lowland semi-evergreen forests to monsoon and montane forests. Most of its natural habitat is affected by shifting or slash-and-burn cultivation (*Jhum*). It is indiscriminately hunted to the brink of extinction almost in its entire distribution range in India. Listed under Schedule II of the Wildlife (Protection) Act, 1972, the IUCN SSC-Red Data Book lists this species in the vulnerable category. Our survey suggests that a suitable habitat of ca. 18,500 km² is available in the northeast and it should be assigned the '*critically endangered*' category in India.

Assamese macaque (*M. assamensis*)

Assamese macaque inhabits all the 7 states of northeast India from the sea level to altitudes of 4,000 m. However, no confirmed



sightings have been reported from Tripura (Dr A.K. Gupta, WII *pers. comm.*). This species occupies tropical, subtropical semi-evergreen forests, dry deciduous and montane forests. Habitat destruction rather than hunting is the greatest risk to its populations in the Northeast India. However, it have been hunted in the Himalayan regions of North Bengal, Sikkim, and Arunachal Pradesh where it invades crop fields frequently. The Assamese macaque is listed under Schedule II of the Wildlife (Protection) Act, 1972. IUCN SSC–Red Data Book places this species in the vulnerable category. Our survey suggests that a suitable habitat of ca. 88,000 km² is available in the northeast and this species should be placed in the ‘*endangered*’ category in India.

Rhesus macaque (*M. mulatta*)

This species inhabits all the 7 states of North-east India from sea level to an altitude of 4,000 m. It inhabits dry deciduous, mixed deciduous, bamboo, and temperate cedar–oak forests to tropical woodlands and swamps. Many Rhesus were seen in areas adjacent to forests rather than in the forest itself. Habitat destruction rather than hunting is the greatest risk to the populations of Rhesus macaques in North and Northeast India. However, they have been protected by Hindu sentiments throughout India since time immemorial. They are listed under Schedule II of the Wildlife (Protection) Act, 1972. CITES places this species in the ‘*lower risk*’ category. Our surveys suggest that a suitable forested habitat of ca. 84,000 km² is available and this species should be considered as ‘*rare*’ in the forest of Northeast India.

Pig-tailed macaque (*M. nemestrina*)

This species inhabits all the 7 states of North-east India from sea level to an altitude of

1,200 m. The northwest limit of its range is south of the river Brahmaputra. It inhabits low-land primary to secondary forests to coastal, swamps, dry land and montane forests. Forest habitats have been disturbed and destroyed by recent human activity in its entire distribution range. To add to this is the fact that these macaques live in low densities and require a larger home range to extract food resources. In the present situation there is hardly any place left that is big enough for Pig-tailed macaques and yet not altered by humans. Consequently most of its natural habitat is affected by ‘*Jhum*’ cultivation. It is listed under Schedule II of the Wildlife (Protection) Act, 1972. IUCN SSC–Red Data Book has placed this species in the vulnerable category. Our survey suggests that a suitable habitat of ca. 18,600 km² is available in the northeast and this species should be placed in the ‘*critically endangered*’ category in India.

Golden langur (*Trachypithecus geei*)

This species was recorded north of the Brahmaputra river between the rivers Manas and Sankosh up to the Bhutan border. The species inhabits sub-tropical moist deciduous forests and moist evergreen forests up to 2,400 m. Ethnic violence that broke out in 1989 in and around the forests inhabited by Golden langurs resulted in loss of these forests. Since these forests became the ‘tragedy of commons’ the Golden langur habitat was reduced by 1/3 in the last 10 years. Though listed under Schedule I of the Wildlife (Protection) Act, 1972, not much protection to the species and its habitat is ensured. IUCN SSC–Red Data Book places this species in the ‘*Data deficient*’ category. Our survey suggests that a suitable habitat of 500 km² is available in the northeast and this species should be placed in the ‘*critically endangered*’ category in India.



Capped langur (*T. pileatus*)

This species inhabits all the 7 states of North-east India from sea level to 2,000 m, and occurs east of the Brahmaputra river, south of the Manas river and eastward through the hills of Northeast India as far as the Upper Chindwin river in north Myanmar. It inhabits sub-tropical evergreen, broadleaf, deciduous, and bamboo forests. Habitat destruction is a major concern for its survival. A proposal has been made to upgrade certain areas to increase protection, and people's participation in any form is a must to save this species. Mostly the species has been hunted for food, as well as for other purposes such as ornamentation, taboo, religious ceremonies, and traditional medicine, without any restriction despite being listed under Schedule I of the Wildlife (Protection) Act, 1972. IUCN SSC–Red Data Book places this species in the *Data Deficient* category. Our survey suggests that a suitable habitat of ca. 84,000 km² is available in the northeast and this species should be placed in the '*endangered*' category in India.

Phayre's langur (*T. phayrei*)

This species inhabits the state of Assam, Mizoram and Tripura from the sea level to 800 m. It inhabits sub-tropical evergreen, broadleaf, deciduous, and bamboo forests. Its numbers are small due to deforestation, which is affecting all the primates of the northeastern states. In addition, it is specifically hunted in areas around salt springs where the species seems to produce large gallstones from the limestone. These gallstones called '*bezoar*' stones are highly prized for their medicinal value by the Chinese, they are also hunted for food by some tribes like *Mizos* or *Lushais*. IUCN SSC–Red Data Book records this species in the '*Data Deficient*' category, and as

'*lower risk*' in CITES-II list. Our survey suggests that a suitable habitat of ca. 5,500 km² is available in the northeast and the species should be placed in the '*critically endangered*' category in India.

Hoolock gibbon (*Bunopithecus hoolock*)

It inhabit all the 7 states of northeast India from 100 to 1,370 m, and the northern, north-east and northwest limit of its range is the river Brahmaputra (Dibang in Arunachal Pradesh) which acts as a physical barrier for its distribution. It inhabits primary evergreen and less seasonal parts of semi-evergreen rainforests and rarely semi-deciduous forests. Habitat loss jeopardizes its survival and it is hunted in its entire range. Hence people's participation in any form is a must to save this species. Mostly hunted for food, it are also hunted for other purposes such as ornamentation, taboo, religious ceremonies, traditional medicine without any restriction, despite being listed under Schedule I of the Wildlife (Protection) Act, 1972. IUCN SSC–Red Data Book record this species in the '*Data deficient*' category. Our surveys suggest that a suitable habitat of ca. 18,500 km² is available in the northeast and if can be placed in the '*endangered*' category in India.

The Golden langurs were not sighted outside their known distribution range, being recorded only from north of the Brahmaputra river between the Manas and Sankosh rivers up to the Bhutan border. Translocated troops occur in the state of Tripura (Gupta & Mukherjee, 1994) and elsewhere but the natural distribution is otherwise restricted to this small region. We could not confirm sighting reports of this langur from the Garo Hills and other sites in the southern part of the Brahmaputra river. Nor could we not locate primate species like



Rhinopithecus roxellanae, *T. cristatus*, and *M. thibetana*, reported earlier from the study area (Roonwal & Mohnot, 1977; Choudhury 1991, 1998). However it is quite likely that these reports were published on the basis of unconfirmed sightings or misidentification. Moreover, several forms are represented by distinct subspecies, such as the Assamese macaque, where the western and eastern subspecies are as genetically distinct as different species of macaque (Wolfheim, 1983). Many species of primates were restricted northwards by a physical barrier like the Brahmaputra river. For example, Stump-tailed and Pig-tailed macaques, Hoolock gibbons and Phayre's langur were not recorded north of this river. Rhesus macaques were encountered more often in areas adjacent to the forest rather than in the actual forest. Capped langurs are the most widely distributed species of all primates, with 5 distinct subspecies encountered frequently, but they occur in very low densities. Phayre's langur was observed thriving well in degraded habitats and bamboo forests. Hoolock gibbons were encountered in low densities in secondary or regenerating forests. These results indicate that all primate species in northern India occur in low densities with low proportions of immatures in their population. Their encounter rate is also low. All these findings are suggestive of population decline. However, census or demographic data prior to our work between 1994 and 1999 are not available for comparison. The loss of primate habitats, hunting and human population pressures are causes for concern.

Conclusions

- Revision of 1996 IUCN–Red Data List of Threatened Animals is urgently required.
- The Wildlife (Protection) Act, 1972 also

needs revision. Several species included in Schedule II, needs to be placed under Schedule I.

- In Arunachal Pradesh, Mizoram and Nagaland, large tracts of primary forests still exist and they retain primate populations.
- Hunting of primates as agriculture pests is a major problem. This is especially true for the Rhesus macaque, which can in fact be quite a significant crop raider and is therefore persecuted. Pig-tailed macaques in Meghalaya, Stump-tailed macaques in Nagaland and Assamese macaques in Arunachal Pradesh are also hunted as pests.
- It is important to note that the primate species in Northeast India have been forced into crop raiding because of loss of natural habitat to agriculture. In some cases, they have clearly learned to coexist with humans by using crops as a significant part of their diet. Conflicts of this kind are likely to increase in the future as the human population continues to grow exponentially in Northeast India.
- Habitat destruction is the most significant threat to the survival of primates in Northeast India. However, it is evident that certain species can survive in disturbed habitats, but the long-term consequences on their reproduction and survival are not known.
- In the last decade or two not much attention has been paid to the plight of primates in India especially in comparison with tigers, rhinos and elephants, and some species are therefore on the brink of extinction.
- Since, habitat loss is the principal threat to primates, habitat protection should be given top conservation priority. Hence, the most valuable direct means of assessing



species conservation is the establishment and management of Protected Areas or the creation of more and more community-based conservation areas.

Recommendations

- Research on population genetics and phylogenetics should be given priority.
- A concerted effort should be launched to protect the prime habitats of endemic and endangered primate species.
- Efforts should be made to raise the awareness of primates, among communities living in the fringe areas.
- To make primate protection more effective and durable in Protected Areas such as National Parks and Wildlife Sanctuaries, we recommend staff incentives and welfare funds. A major portion of the revenue generated by the Park or Sanctuary should be spent on its development and staff welfare.
- Rigorous and regular training programmes and refresher courses for forest staff are necessary to keep them informed, updated, trained and suitably equipped.
- More trained staff is needed to protect the rich wildlife and its habitat in Northeast India.
- Emphasis should be given to eco-tourism in the area. Publicity through newspapers, TV coverage, and media reporting should be encouraged to generate awareness in the local people and to generate good revenue for the sanctuary. The revenue so generated should be used for the upkeep of the Sanctuaries.
- Conservation education and conservation action plans should also involve NGOs,

and the local communities that live in and around forested areas.

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We are happy to record the help of the survey team of this project. In particular P. Sarkar, D. Chetry, J. Das, J. Biswas, P. Bujarbaruwa, R. Medhi, and G. Ahmed. We were assisted by several of our colleagues from the Forest Department from Forest Guards to the Principal Chief Conservator of Forests and their help and support is greatly acknowledged. We are also thankful to I. S. Bernstein, C.H Southwick and P. C. Bhattacharjee for their constant support. This research is a part of a cooperative programme of the Ministry of Environment and Forests, Government of India and US Fish & Wildlife Services (Grant Agreement # INT/FWS-22).

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Status of Primates in Andhra Pradesh

C. Srinivasulu & V. Nagulu

Introduction

Andhra Pradesh is the fifth largest state of India (12°30' and 20°0' N & 76°30' and 85°0'), with an area of 2,75,068 km². It sprawls across a greater part of the Deccan Plateau and has boundaries touching those of Orissa and Madhya Pradesh and Chattisgarh along the northeast, Maharashtra on the north, Karnataka on the west, Tamil Nadu on the south and Bay of Bengal along the east. A variety of forest types are found in the state, ranging from hills of the Eastern Ghats and moist to semi-evergreen forests in the riverine tracts of the mighty Godavari and Krishna. Other areas of the state are dominated by dry deciduous and open scrub, with patches of mangroves along the Godavari and Krishna estuaries. With a forest cover of 23.19% (63,814 km²; ICFRE, 1995), it is fourth in terms of forest cover in the country. The principal forest types (Champion & Seth 1968) of the state are Tropical Dry Deciduous forest (5A/C1), Southern Tropical Thorn forest (6A/C1), Southern Tropical Moist Deciduous forest (3B/C2), Littoral forest (4A/L1) and Tidal Swamp Mangrove forest (4B/TSL). Dense forests cover an area of 25,008 km², followed by open forest (21,870 km²), scrub (12,170 km²), and mangrove (390 km²).

Of a total of 23 districts the most forested is

Abstract

We briefly review the natural history, district-wise distribution and present-day status of non-human primates known to occur in Andhra Pradesh. *Loris tardigradus* is restricted in distribution to 3 southern districts, while the other species, *Macaca mulatta*, *M. radiata* and *Semnopithecus entellus*, have been recorded throughout the state. Excepting *Loris tardigradus*, whose populations are under severe pressure due to rampant killing spurred by superstitious beliefs and the need for folk medicine, populations of other species are under moderate to low killing pressure and subject to lesser man-monkey conflicts.

Khammam (45.4%), followed by Adilabad (40.2%) and East Godavari (33.3%), while the least forested are Nalgonda (1.1%) and Anantapur (2.0%). Three districts have forest covers of above 33% of the total geographical area of their own, 5 districts have forest covers ranging between 19–33% and in 15 districts the forest cover is >19%. Districts with less than 19% forest cover are Anantapur, Chittoor, Guntur, Hyderabad, Karimnagar, Krishna, Kurnool, Medak, Mehbubnagar, Nalgonda, Nellore, Nizamabad, Prakasam, Ranga Reddy and West Godavari (FSI, 1999).

Of the 15 species of non-human primates recorded from India, 4 species occur in



Andhra Pradesh. In this paper, we briefly review the distribution and status of the primates of Andhra Pradesh. The data on population estimates are yet to be analysed and are not presented in this communication.

Slender Loris (*Loris tardigradus*)

This is a rare primate in the state, restricted to the districts of Chittoor, Cuddapah and Nellore (Table 1). Excepting the Chittoor district, the population seems to be on the decline in other areas. Threats to the species include habitat fragmentation and killing for folk medicine (Molur *et al.*, 1998).

Rhesus Macaque (*Macaca mulatta*)

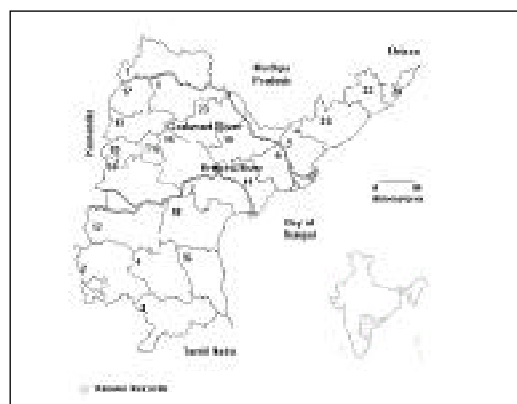
Common all over the state, they either occur naturally or have been introduced (Table 1). A population of 60–80 individuals has been recorded from the mangroves of the Godavari estuary. The population trend shows increasing numbers in areas where the species has been introduced, while in other areas it is stable, and decreasing in and around the twin cities of Hyderabad and Secunderabad and their environs (Srinivasulu, 1999).

Bonnet Macaque (*M. radiata*)

A common species, it has been recorded from all districts in the state (Table 1). This species shows a stable population trend throughout the state except East Godavari, West Godavari and Hyderabad districts, unlike the Rhesus macaque. Loss of habitat seems to be the major threat (Molur *et al.*, 1998).

HanumanLangur(*Semnopithecus entellus*)

This is also a common species in the state (Table 1). Good populations have been recorded all along the forested tracts of the state.



Numbers indicate the sequence of districts represented in Table 1



However, their population is on the decline in many areas as sightings have become rarer. Otherwise in 16 districts of the state the population is stable (Srinivasulu, 1999).

Conservation Issues

There is no published document that cites hunting or poaching of primates in areas dominated by tribal populations in the state. Although, researchers of the Sri Venkateshwara University, Tirupati, have reported many instances of killing of *Loris tardigradus*, we have only one instance of hunting of the Hanuman langur by the Koyas in Eturnagaram Wildlife Sanctuary near Kamaram village.

Rhesus and Bonnet macaques have been problematic in some towns and cities from where many have been captured and released in forested tracts of the state, especially in the protected areas where pilgrim tourism exists. In certain areas where such release programmes have been undertaken, the monkey menace has resurfaced resulting in an increase in man–monkey conflicts.

Research on Primates in the State

There have been very few scientific studies or research projects on primates in Andhra Pradesh. Some of the studies worth mentioning are The Ecology of the Rhesus Macaque in Osmania University Campus, Hyderabad, and The Ecological Study of the Slender Loris in the Seshachalam Hills by Prof. N. Nanda Kumar of Sri Venkateshwara University, Tirupati, in collaboration with the Andhra Pradesh Forest Department, World Health Organization. More detailed studies are needed on the effects of biotic pressures and habitat fragmentation, and conservation of primates in the state.

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Table 1. District-wise Status of Primates in Andhra Pradesh

S. No.	District	Percent Forest Cover	No. of Protected Areas	L. tardigradus		M. mulatta		M. radiata		S. entellus	
				1	2	1	2	1	2	1	2
1.	Adilabad	44.8	3	A	–	P	In	P*	In	P	St
2.	Anantapur	10.3	–	P?	NA	P*	In	P	St	P	De
3.	Chittoor	29.9	2	P	St	P*	In	P	St	P	St
4.	Cuddapah	32.0	2	P	De	A	–	P	St	P	St
5.	Godavari, East	29.9	2	A	–	P	St	P	De	P	De
6.	Godavari, West	10.4	2	A	–	P	In	P	De	P	St
7.	Guntur	14.2	2	A	–	P*	In	P	St	P	St
8.	Hyderabad	–	2	A	–	P	De	P	De	P	De
9.	Karimnagar	21.6	1	A	–	P	St	P*	In	P	De
10.	Khammam	52.7	2	A	–	P	St	P	St	P	St
11.	Krishna	7.6	1	A	–	P	St	P	St	P	St
12.	Kurnool	19.8	2	A	–	P*	In	P	St	P	St
13.	Medak	9.4	2	A	–	P	St	P	St	P	St
14.	Mehbubnagar	16.5	1	A	–	P	St	P	St	P	St
15.	Nalgonda	5.9	1	A	–	P	St	P	St	P	St
16.	Nellore	19.2	2	P	De	P*	in	P	St	P	De
17.	Nizamabad	22.6	1	A	–	P	St	P	St	P	De
18.	Prakasam	24.1	2	A	–	P*	in	P	St	P	St
19.	Ranga Reddy	9.7	1	A	–	P	De	P	St	P	De
20.	Srikakulam	11.9	–	A	–	P	St	P*	St	P	St
21.	Vishakapatnam	39.3	–	A	–	P	St	P*	St	P	St
22.	Vizianagaran	18.3	–	A	–	P	St	P*	St	P	St
23.	Warangal	28.8	2	A	–	P	St	P	St	P	St
	Total	23.19		P(3) & + ?(1)		P(16) & P*(6)		P(18) & P*(5)		+ (23)	

1—Distribution Status, 2—Population Trend

'P'—Present, 'A'—Absent, 'In'—Increasing, 'St'—Stable, 'De'—Decreasing, '?'—Probable, '*'—Introduced, 'NA'—Data Not Available

Status and Distribution of Primates in Arunachal Pradesh

D. N. Singh

Introduction

Arunachal Pradesh is situated between 26°–29° N to 29°–30° N (latitudes) and 91°–30° E (longitude) covering a geographical area of 83,743 km². It is the largest of the 7 states in Northeast India. The state is mostly hilly and flanked by Tibet in the north; separated by McMahon Line, by Bhutan in the west, by China and Myanmar in the east and by the Indian states of Assam and Nagaland in the south. It is predominately a tribal state with more than 82 major tribes and sub-tribes of Indo-mongoloid and Mongoloid lineage residing in the state, and who are largely dependent on forest resources for their sustenance. However, because of sparse population density (10 persons/km² as per 1991 Census), the tribal people of this state have been living in perfect harmony with forests for centuries. This harmonious relation between the people and forests has been disturbed in recent times due to increasing pressures from human populations, and large developmental projects which have been taken up to give a boost to the region's economy.

Physiographically, the state is divided into 3 sections, viz., the flood plains of the mighty Brahmaputra river and its tributaries, the foothills of the Shivalik range and Changlang dis-

Abstract

The northeastern state of Arunachal Pradesh which constitutes the major portion of the eastern Himalayas, is one of the two biodiversity hot spots in India, of 25 global biological diversity hot spots all over the world. Arunachal Pradesh is home to 4 genera and 8 species of non-human primates. The common langur (*Semnopithecus entellus*), has not been observed during this study, although in some literature it has been reported from this state. The snub-nosed monkey (*Rhinopithecus roxellanae*), a Chinese species, is also reported from the higher elevations along the Indo-China and Indo-Myanmar borders. The present communication attempts to study distribution and present status of primates in Arunachal Pradesh.

tricts (Patkal range), which is not part of the eastern Himalayas.

Biogeographically, the entire state is located in the Oriental and the Palearctic Bio geographic realm of the Indian sub-continent biogeographic region. It is in the Himalayan biogeographic zone and the eastern Himalaya (2D) biogeographic province (Rodgers & Panwar, 1988). However, the entire Tirap district of the state and the part of Changlang district, falling south of Chokan Pass and Noa-



Dehing (Diun) river are situated in the Patkai Mountain Range. As such bio geographically, this belt of the state falls under the northeast Hills (9B) biogeographic province, of the north-east India Zone (Rodgers & Panwar, 1988). The state is also bio geographically important because it falls in the transition zone between the Indian sub continent and Indo-Chinese biogeographical regions (Dinnersten *et. al.*, 1997).

The state has a wide altitudinal variation ranging from 50 m, in the foothills to about 7,000 m along its northern parts. The highest peak (7,090 m) is in the northwestern Tawang district of the state. The area is drained by a number of rivers and rivulets, the important ones being the Kameng, the Subansiri, the Siang (Tsangpo in Tibet), the Dibang, the Lohit, the Noa-Dehing (Diyun) and the Tirap. All these rivers give rise to the mighty Brahmaputra.

The state also falls in one of the heaviest rainfall zones of the country. The annual rainfall is spread over 8–9 months and varies from 1,000 mm in the higher reaches to 3,500 mm in the foothills. The pre-monsoon showers start from March, the monsoons being active from May to September, and the retreating monsoon showers are received during October and November, with the humidity during the rainy season rising up to 90%. This diversity of topographical and climatic conditions has favoured the growth of luxuriant forests, which are home to a myriad plant and animal forms. Consequently, 3 broad climatic zones are recognized viz. the hot and humid sub-tropical areas at the foothills, the cooler temperature zone of the lesser Himalayas and the alpine zone of the greater Himalayas. The soil in the major parts of the state are rocky consisting of shales, schist and conglomerates. In the lower elevations of the valleys, it is acidic due to high rainfall but rich in humus content.

The vegetation of Arunachal Pradesh is classified into 5 broad forest types and a distinct secondary forest type, largely man-made (Anon., 1999). These are:

1. Tropical Forests
 - (a) Tropical Evergreen Forests
 - (b) Tropical semi-evergreen Forests
2. Sub-tropical Forests
3. Pine Forests
4. Temperate Forests
 - (a) Temperate Broad-leaved Forests
 - (b) Temperate Conifer Forests
5. Alpine Forests
6. Secondary Forests
 - (a) Degraded Forests
 - (b) Bamboo Forests
 - (c) Grasslands

The varying climatic and altitudinal conditions that range from tropical to alpine climate offer conditions congenial to the growth of a wide range of flora thereby providing food and cover to many wild animals.

Primates in India, are represented by 7 genera, 15 species and 39 subspecies, which is 12% of the world's total species and subspecies of non-human primates. In Northeast India, 5 genera and 11 species of non-human primates are found, and Arunachal Pradesh is home to 4 genera and 8 species of non-human primates. Chatterjee and Chandiramani (1986), Mehta (1987), and Chatterjee (1989) have reported the presence of the common langur (*Semnopithecus entellus*) in the state. However, during the present study no sighting or anecdotal records of the Common langur in the state were made. The Common langur has not been reported from the Northeast region (Choudhary, 1989), but for the state of Tripura and Sikkim (Borang & Thapliyal, 1993).

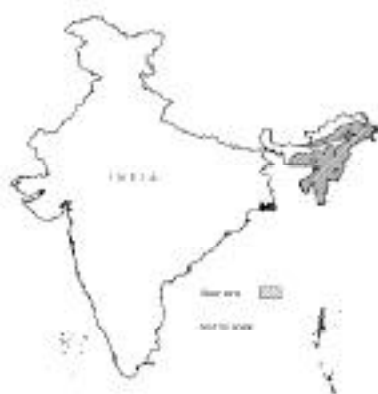


The Snub-nosed monkey (*Rhinopithecus roxellanae*) from China has been reported in the past from Manipur and northern Assam in the northeast by Roonwal & Mohnot (1977) and Roonwal (1989). It may stray into the higher elevations. However, this species has been reported from the forests of Tawang district of Arunachal Pradesh bordering China (T. Riba, DFO Tawang, *pers. comm.*).

1. Slow Loris (*Nycticebus coucang*)

Distribution: The Slow loris is found throughout the state mainly in the dense tropical forests up to an elevation of 800–900 m.

Status: Although, no status survey has been done in the state, deforestation due to *jhumming*, developmental projects and timber felling in the tropical forests all over the state is likely to cause irreparable damage to its habitat. Therefore, the species is under serious threat in the state.



2. Rhesus Macaque (*Macaca mulatta*)

Distribution: It is the most common primate species of the state recorded from low-lying land at the foothills to an elevation of 1,000 m in all major vegetation types. For a distribution map, refer to A.K. Gupta in this issue.

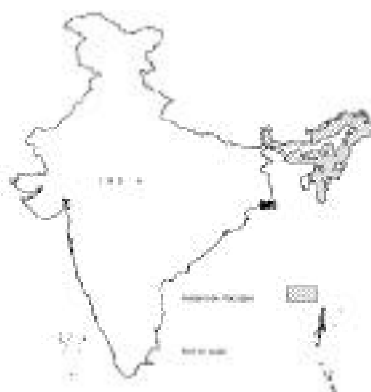
Status: Status surveys have not been done in this state, however, there is need for better protection of its habitat, as the long term sur-

vival of this species is completely dependent on forests, unlike the Rhesus of northern India who are also found in cities and villages. The bold and aggressive Rhesus macaque is very shy and secretive throughout Arunachal Pradesh and it is rare to see a Rhesus macaque coming near humans in this state. This changed behaviour is due to hunting by the tribal people for food, medicine and other ethno-zoological reasons.

3. Assamese Macaque (*M. assamensis*)

Distribution: It is the second most common primate species, next to Rhesus, in Arunachal Pradesh. It is found in all types of dense forests including bamboo forests starting from the foothills to an altitude of 2,000 m.

Status: Status surveys of this macaque are lacking, however, the present population of this species in the state is under threat due to destruction and damage being caused to its habitat. These macaques are hunted by the tribal people of the state for food and for medicinal purposes. The Adi tribes of Arunachal Pradesh eat the flesh of this macaque during epidemic diseases. Some parts of the body (palm, fingers and skull) are hung at the main door of the house to keep away evil forces and spirits.



4. Stump-tailed Macaque (*M. arctoides*)

Distribution: The Stump-tailed macaque inhabits the tropical wet evergreen and tropical





semi-evergreen moist forests of Tirap, Changlang and Lohit districts extending up to the south bank of the Lohit river in Arunachal Pradesh. This range falls within the Mishmi Hills and the Patkai Ranges. It is found in 2 Protected Areas of the state, namely the Namdapha National Park (Tiger Reserve) and the Kamlang Wildlife Sanctuary.

Status: Sightings of this macaque are very rare with very few records in the Namdapha National Park (4 sightings of the troop by the author in a span of two and a half years, and 2 additional sightings by the research staff of Namdapha Tiger Project, *pers. comm.* A.K. Das). It is imperative to mention here that the habitat of this species in the Tirap and Changlang district is under serious threat due to *jhumming* and large-scale deforestation and clearing of the forests for tea cultivation. These macaques have been observed to move in groups. In Namdapha National Park the author saw one troop consisting of 13 individuals in the forests between M'Pen and Gibbons land. They were observed feeding on the grounds while some were on the tree branches.

5. Pig-tailed macaque (*M. nemestrina*)

Distribution: The Pig-tailed macaque is found in the tropical rainforests in the Tirap and the Changlang districts of Arunachal Pradesh. The author as well as other research personnel

have sighted this macaque in the rainforests of the Namdapha. For a distribution map refer to A.K. Gupta in this issue.

Status: The sightings of the Pig-tailed macaque are rare with only 2 sightings in two and a half years inside Namdapha (January 1998–June 2000) by the author. An extensive survey is required in all the Tirap and Changlang districts to ascertain its present status. It is restricted to only one Protected Area throughout the state, the Namdapha National Park.

6. Capped Langur (*Trachypithecus pileatus*)

Distribution: This species is found all over the state, inhabiting the tropical semi-evergreen, moist evergreen and deciduous forests, except for the strip of the land falling in between the Siang and the Dibang rivers. For a distribution map refer to A.K. Gupta in this issue.

Status: The Capped langur is a very common primate species in the state, after the Rhesus and the Assamese macaque. However, it is under tremendous threat due to deforestation and poaching for food and medicine.

7. Snub-nosed Monkey (*Rhinopithecus roxellanae*)

Distribution: The Snub-nosed monkey is found in Szechuan and Sikang provinces of China and Upper Myanmar. This species strays into the higher altitudes of the state adjoining China and Myanmar. It has been sighted in the Tawang district and Vijoynagar Circle of Arunachal Pradesh bordering China and Upper Myanmar. Sri R. Riba (DFO Tawang), and his staff have sighted this monkey in the forests of the Tawang Forest Division. It has been hunted during November 1997 by a hunter belonging to the *Lisu* tribe from the higher

reaches of the mountains surrounding Vijoy-nagar Circle in the Changlang district bordering Upper Myanmar. (Sri Phuyosa Ngwazah, *Lisu* tribe of Vijoy-nagar Circle, Namdapha Tiger Project, *pers. comm.*).

Status: This primate strays into the bordering areas of Arunachal Pradesh from China. However, it can be found in the Dibang Valley and Upper Siang district of Arunachal Pradesh bordering China.

8. Hoolock or White-browed Gibbon (*Bunopithecus hoolock*)

Distribution: The only ape species in India, it is confined to the southern and the eastern parts of the state in the dense tropical semi-evergreen, wet evergreen and moist deciduous forests of Tirap, Changlang, Lohit and Dibang Valley districts, while it is not reported west of the Dibang river. Earlier it has been reported in Subansiri district during the Subansiri Expedition of ZSI in 1974–75 (Borang & Thapliyal, 1993). However, during the present study no report, evidence or sightings of the species were recorded anywhere west of the Dibang river. This ape is confined to the south and the east bank of the Dibang–Brahmaputra river system.

Status: Although no survey has been carried out to know the exact status, it is under serious threat due to poaching and habitat destruction. Although sighted in the forests throughout its range, troops of Hoolocks are larger in the Namdapha Tiger Reserve and the Kamlang Wildlife Sanctuary.

Discussion

Rhesus and Assamese macaques are the 2 most common primates found in the state. Although, the habitat of these 2 species are

similar, hunting by the tribals of the state has made the Rhesus macaque shy and wary of the humans, unlike its behaviour in other parts of India, where it is closely associated with the human settlements and is largely found in and around cities and villages. The Capped langur is also found all over the state except for the strip of the land between the Siang and the Dibang rivers. The Snub-nosed monkey is found in the high mountains along the Indo-China and the Indo-Myanmar border. The probability of this primate inhabiting the high mountains in the Dibang Valley, the Upper Siang and the Kurung–Kumey district is very high since it has been observed in the Tawang district.

The Slow loris is rare and found in the dense tropical rainforests all over the state. The Hoolock gibbon is restricted to the eastern and the southern parts of the state, east of the Dibang river. The population of this species has gone down drastically over the years, which is evident from the fact that the frequency of its songs has become rare. The Pig-tailed and Stump-tailed macaques inhabit the tropical wet-evergreen and semi-evergreen forests of the Tirap, the Changlang and the part of Lohit district south of the Lohit river. However, the population of these 2 species is not dense in their habitats in the state.

Conservation Threats

The main conservation threats to the primates' populations in the state are:

Shifting cultivation: Practised in the state up to an elevation of 2,000 m. It is important to note that all primates are also distributed up to an elevation of 2,500 m. Thus, the burden of shifting cultivation is more on the habitat of non-human primates in addition to other wild



animals in the state. It is estimated that the area under shifting cultivation in the state is > 920 km² in any given year. Shifting cultivation is practised more in the Subansiri, Papumpare, Siang, Lohit, Tirap and Changlang belts ranging from tropical wet evergreen forests to pine forests. The cycle of shifting cultivation was 3 years in Tirap and Changlang, 6 years in Lohit and Siang and 10 years in the Subansiri area has now reduced considerably to 2–4 years everywhere causing immense damage to the habitat of primates. Shifting cultivation is somewhat beneficial to successful colonizer species, such as Rhesus macaques, but is largely harmful to most other species, which are unable to adopt.

Development activities: The planner and leaders of this remote and backward area are trying hard to develop the infrastructure sector, thereby accelerating the pace of economic development. Consequently, construction of roads, bridges, dams, hydel power projects and development of townships has been taken up on a large scale. Such developmental projects in these hilly areas have been taken up without any Environmental Impact Assessment. The result is deforestation, soil erosion and damage to the ecological balance. In the economically backward districts of Tirap and Changlang, tea plantations are being carried out along the steep slopes. All these activities are a potent threat to the future of primates. Although the tribal people of this area are backward and their quality of life needs to be improved, a balance needs to be maintained between development and environmental conservation.

Hunting: The tribal people of Arunachal Pradesh occasionally hunt primates for medicinal purpose or to save their crops (Borang & Thapliyal, 1993). However, some tribes also

practise hunting for meat. The low population density of the tribals compared to large forest areas in the past did not pose any threat to the population of primates. Nevertheless, over the years, their population has increased due to better medical aid. Added to this, is the fact that large-scale deforestation has taken place due to greater demand for timber. Thus, with the increase in the local population, the forestland available per capita is going down. Consequently, the delicate balance between man and environment is under threat.

Need for Future Work

There is an urgent need for quantitative information on the status, habitat and demographic profile of the primates in the state. Given the nature and the extent of habitat fragmentation and the fact that a majority of the remaining forests are in the form of fragments, it is essential that corridors be developed between these widely spaced small fragments of forests, for the long-term survival of primates. Apart from this it is equally important that conservation education and awareness programmes be carried out in the state to increase the awareness levels in the local communities. Environment Impact Assessment studies need to be commissioned that would look into the impacts of development projects on the forests and its fauna and flora in the state. This would minimize the negative impacts of future development projects on the states' forests.

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Primates of the Amarkantak Forests, Madhya Pradesh

R. J. Rao & Abhishek Bhatnagar



Introduction

Most primates live in tropical, developing countries and humans compete with them for resources. In many parts of the world, primates are exploited for food, 'medicine', and commercial trade, besides being killed or poisoned, for being crop raiders. The alarming rate of worldwide tropical forest destruction is estimated to be 200 acres per minute. Over 40% of the 234 primate species are threatened with extinction and 13 of these species are critically endangered and may disappear within the next few years if greater efforts aren't made to protect them (www.primate.org).

Madhya Pradesh is one of the major forest rich states in the country, with 25 Wildlife Sanctuaries and 9 National Parks (Anon., 2000). Recently, the Pachmarhi forest area has been declared as a Biosphere Reserve, and there is a proposal to declare the Amarkantak forests also as another Biosphere Reserve in the state. Various research studies have been initiated in the Amarkantak forests to assess the suitability of the area for its declaration as a Biosphere Reserve. This brief report on the primates of Amarkantak is part of such research studies.

The study aimed to assess the impact of forest product extraction on the population status and conservation of two primate species in

Abstract

In the Amarkantak forests, Madhya Pradesh, we are monitoring primates (Langur and Rhesus monkey), in both disturbed and undisturbed forest sites to determine if extraction of forest resources has a significant impact on the populations of these species. To test the sensitivity of primate species to routine extraction of natural resources by local villagers, we compared population demography and density for both the species in different localities. Population densities at each site and estimates of population size across the entire forests was calculated and used to evaluate the design of a new biosphere reserve in the area, and to ensure that it will be large enough to support viable populations of these threatened primates.

the Amarkantak forests, to help managers in designing the Biosphere Reserve and Forest Management Zones for the region. The study further aims at long-term monitoring trends in the population dynamics of primates, as indicator species for a better understanding of the influence of forest product extraction on forest ecology.

Study Area and Census Methods

The study was conducted in the Amarkantak forests located in the Shahdol district. The

Amarkantak range is spread over an area of 835 km² with 2 circles namely Amarkantak circle (336 km²) and Bhundocoona circle (499 km²).

Primate census was conducted following Merenlender *et al.* (1998). This method relies on repeatedly identifying social groups, and obtaining demographic data on all the identified groups.

At most sites, data was collected on pre-existing trails (marked at 50 m intervals) that had either been created by villagers for forest product extraction, or by researchers working in the area. However new trails were also cut afresh wherever needed. The team consisted of a researcher and 2 villagers who were trained in data collection. Each trail was surveyed from early morning to early afternoon, at a slow pace. During the census period, all detectable groups were identified to count total numbers and determine the age, sex classes (adults, juveniles, and infant females and males) whenever possible. Information was also collected on: total groups, closest trails, approximate distance from the trail marker to where the animals were found, and details on feedings and behaviour. Data collections were repeated 5–8 times at each site, over 3-day periods.

Results

Amarkantak Forests

The forests of the Amarkantak plateau represent tropical moist deciduous forests. The valleys have Sal (*Shorea robusta*) as the dominant species. The vegetation abruptly changes to mixed forests on the plateau and slopes. According to a study conducted by the State Forest Research Institute on vegetation characteristics during 1995 in Amarkantak range, a maximum of 48 tree species (density of 1269 trees/ha.), the plains with 24 species (1354 trees/ha), and 24 species on the slopes (density of 1274 trees/ha) were recorded. *Shorea robusta* (sal), *Terminalia bellerica* (saja), *Emblica officinalis* (aonla), and *Madhuca indica* (mahua) regenerated profusely compared to *Syzgium cumini* (jamun) and *Meliusa velutina* (kari).

Primate Species

Only 2 primates species have been recorded from the Amarkantak range: the Common langur (*Semnopithecus entellus*) and the Rhesus macaque (*Macaca mulatta*), and their population estimates have been provided in Table 1.



Table 1. Primate Populations in Amarkantak Forests

S. No.	Site	Species	Group size	Location*
1.	Forest School	CL	26	1 km North
2.	Sonumura	CL RM	30 15	3 km East
3.	Shambhudhara CL	28 RM	28 28	3 km North
4.	Rudraganga	CL	25	3 km East
5.	Kapildhara	CL	36	5 km West
6.	Kabir chabutra	CL	30	5 km South

*Distance from Amarkantak village

CL: Common langur, RM: Rhesus macaque

Human Activities

This study has identified 4 major types of human disturbances, which are likely to affect the primate habitat (Table 2). These are:

1. Mining: In Amarkantak forests 2 mines belonging to HINDALCO and BALCO, extract bauxite by the open cast mining technique. At present only HINDALCO is extracting bauxite while the other is closed. Mining activity involves cutting down natural forests, which are substituted through mandatory monoculture plantations using eucalyptus and some fruit

an average 2–3 langurs dying in road accidents every month.

4. NTFP Collection: People residing in and around Amarkantak forests collect various non-timber forest products (fuel wood, fodder, fruits, gums, seeds, and medicinal plants) for their daily subsistence. Surplus collections are also sold in the local market for a livelihood.

Conclusion

Humans who damage their habitat and are also involved in commercial hunting for food

Table 2. A profile of the human activities in Amarkantak forests

S. No.	Site	Human activities					
		Mining	Tree	Pilgrimage felling	Tourist	Road Traffic	NTFP Collection
1.	Forest school	–	+	–	–	–	–
2.	Sonmura	–	++	+++	+++	+++	+
3.	Shambhudhara	++	++	+	+	–	+++
4.	Rudraganga	–	–	+	+	+	+
5.	Kaildhara	+	+	+++	+++	+++	++
6.	Kabirchabutra	–	–	++	+	+	+

–Absent, +Low, ++Medium, +++Heavy

trees. However, even these species don't grow, due to heavy grazing pressure in the area. Mining activities are present in 2 study sites: 3 and 5 (Table 2).

2. Tree felling: Large-scale felling of trees was found at 4 study sites (Table 2). Besides this, due to heavy infestation by sal borer (*Hoplocerambix spinicornis*) since 1998, the Forest Department had to cut around 20,000 affected trees.

3. Pressures of Pilgrimage, Tourist and Road Traffic: Amarkantak forests attract thousands of tourists, especially during Shivratri and Dussehera, which, has lead to the damage of these forests and road accidents; with

and pets threaten primates in Amarkantak forests. A primate group size is often associated with resource distribution and abundance (Chapman, 1990). Primate groups found in disturbed or marginal forests may be smaller when available resources are limited, or larger if regenerating forests produce increased food resources (Ganzhorn, 1988, Olupot *et al.*, 1994). Primates in Amarkantak forests suffer from 2 major threats: a) fragmentation and loss of habitat due to conversion of forests for mining and b) high level habitat alteration following selective extraction of timber and non-timber forest products which adversely affects primate populations.

It is recommended that the area be declared



a Biosphere Reserve and an overall Conservation and Resource Management Strategy be prepared for the entire Amarkantak Biosphere Reserve.

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Status of Primates in Orissa

L. N. Acharjya



Introduction

Orissa is situated on the Bay of Bengal along the eastern seaboard of peninsular India and lies in the tropical zone. The state receives a fairly high amount of rainfall and offers suitable habitat for varied fauna and flora that have been recorded from a range of habitat types—from dry scrub forests to the coastal mangrove formations. With ca. 5.12% of its area under the PA network (Rodgers *et al.*, 2002), a total of 86 mammal species have been reported from the state. Of the 15 species of non-human primates in the Indian region, only 3 species belonging to one family and 2 genera are known to occur in Orissa: 2 species of macaques, and one species of langur. The present communication embodies information in brief about the existence, distribution and present status of these primates in Orissa.

Rhesus Macaque (*Macaca mulatta*)

The Rhesus macaque is found all over the state including the mangrove swamps (Anon., 1992; Mishra *et al.*, 1996). Behura & Guru (1969) also reported its presence in Orissa. The Zoological Survey of India (ZSI) has collected specimens of the Rhesus from Sambalpur, Deogarh, Puri and Bolangir districts (Das *et al.*, 1993). Several specimens of this species, maintained as pets by individuals across the

Abstract

The state of Orissa falls under 2 Biogeographic Zones—the Deccan Peninsula and the Coasts, and supports 18 Wildlife Sanctuaries and 2 National Parks. Three species of non-human primates have been reported from the state: the Rhesus and Bonnet macaques and the Common langur. While the status of Bonnets is unclear, the other 2 species are quite common and at times are pests for the people of the state. Although there has been no detailed study on primates in the state, habitat fragmentation is likely to be a major cause of concern for the long-term survival of these primate populations in the state.

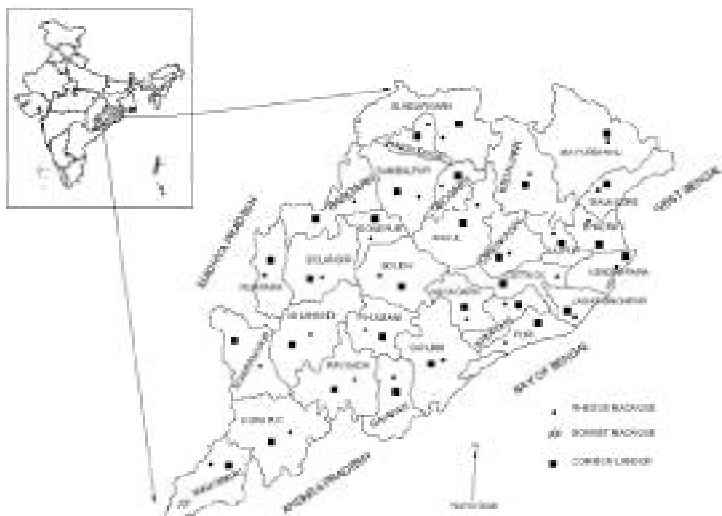
state have been taken to the Nandankanan Zoological Park (NKZP) since 1961 for better upkeep and as exhibits.

Large troops are commonly seen in and around the famous temples at Puri, Bhubaneswar, Chandikhole, Mahavinayak (Jaipur district) and other places frequented by tourists. The Rhesus populations here subsist on food offered by the tourists and are also known to steal food from them.

Bonnet Macaque (*M. radiata*)

Its distribution in Orissa is restricted to Malkangiri district, bordering Andhra Pradesh

Primates species distribution in Orissa



(Anon., 1992; Mishra *et al.*, 1996). Das *et al.* (1993) and Behura & Guru (1969) have not listed it in their reports on mammals found in Orissa. Surprisingly no specimen of this species has ever been received at the NKZP from any part of Orissa since its inception in December 1960. However, several specimens collected from outside the state have been on regular display at the NKZP since 1961.

Common Langur (*Semnopithecus entellus*)

Its occurrence in Orissa has been reported without being location specific (Behura & Guru, 1969) and is considered to be found all over the state (Anon., 1992; Mishra *et al.*, 1996). Das *et al.* (1993) reported its existence in Sambalpur, Phulbani (Kandhamals) and Ganjam districts on the basis of specimens collected by the ZSI. Panda & Bohidar (1997) studied their feeding habits in and around some villages of Bhadrak district. Though they are more arboreal than macaques, large troops are seen on the ground, rocks and roadsides seeking food from tourists visiting the Khandagiri and Udayagiri caves on the outskirts of Bhubaneswar. A number of speci-

mens of this species have been collected/received from areas in and around the NKZP and exhibited continuously since 1964.

Present Status and Threats

Rhesus macaques and common langurs are commonly encountered throughout the state both in forested areas as well as in towns and villages raiding crop fields, horticultural and vegetable gardens and stealing food

from visitors at tourist spots. But they are simply driven off without being harmed because of religious sentiments attached to these species, which help in their conservation. The status of the Bonnet macaque is unknown.

The main threat for the primates in Orissa appears to be the gradual loss of habitat due to deforestation. No detailed primate studies have been undertaken in Orissa as yet. A detailed survey, to begin with, is needed to establish their habitat, distribution, population structure and conservation issues.

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Status of Primates in Tripura

A. K. Gupta

Introduction

Tripura is a small state, with a total area of 10,470 km², located in Northeast India. This small geographical area, however, does not deprive this state of being one of the richest areas in biodiversity and biological resources. Tripura owes this rich biodiversity and copious wealth of biological resources to its unique Bio geographical (8B Assam Hills) and Zoogeographical (Indian sub-region of Oriental Zoogeographical Region) location and position. Although, by virtue of its location in Assam Hills, Tripura is part of the Indian sub-region of Oriental Zoogeographical Region, the flora and fauna in this state bear close resemblance to the floral and faunal components of Indo-Malayan and Indo-Chinese sub-regions of the Oriental Region. In addition to this, the flora and fauna in Tripura also has a close affinity with Ethiopian and Palaearctic Zoogeographical Regions.

Assam and the adjoining areas (Tripura included) hold a pivotal place in the historic process of progressive evolution of present day fauna of India as these served as effective gateways to floristic and faunal influx. This region served as a great faunal gateway through which not only the Indo-Chinese and Indo-Malayan elements of the Oriental fauna, but

also the fauna of Ethiopian and Palaearctic Regions could enter India and colonize the country. In more recent times, a geographical and climatic discontinuity has developed between Assam and the rest of India in the region of Garo–Rajmahal Gap visible as distinctive dispersal breaks. These breaks have since acted as filters and barriers in the effective dispersal of mammals either way. As a result of this, the region, which also includes Tripura, has remained the westernmost boundaries of the distribution range of many of the Indo-Chinese and Indo-Malayan mammals (certain squirrels), and the easternmost limit of the distribution of many peninsular species (e.g., Spotted Deer).

Tripura has an amazingly high density of primates all over the state, including some highly endangered species. Different survey teams from the Zoological Survey of India, Eastern Region, Calcutta have reported that of a total of 15 free-ranging primate species in India, 7 (46.7%) species are found in Tripura, which is the highest for any one Indian state. In 1989, based on the primate survey conducted by the author all over the state, a total of 287 groups of all the 7 primate species were located in Tripura (Gupta, 1996). In 1994, primate survey in Sepahijala Wildlife Sanctuary



revealed the presence of 5 species in very high density. In 1988, one more primate species was added to the list of the 7 free-ranging primates in the state, when 2 groups of the Golden langur (*Trachypithecus geei*) were re-leased in the wild at Sepahijala and Trishna Wildlife Sanctuary (one group in each area). Of these 2 groups, the one in Sepahijala has survived well and with a suitable increase in its population size has further spilt into 2 sub-groups (Gupta & Mukherjee, 1994). Some primatologists (Mukherjee & Chakraborty 1992) and Chaudhury (this volume) have reported the presence of the Hanuman langur (*Semnopithecus entellus*) and Assamese macaque (*Macaca assamensis*) from Tripura, but the author did not find any of these 2 species in Tripura.

The present communication reports the present status and distribution of primates from the state and also gives a brief idea of their ecology and habitat requirements. Conservation issues faced by these primates are also discussed.

Slow Loris (*Nycticebus coucang*)

Loris (2 species) are the only nocturnal (active during the night) species in this part of the world. Of these, the Slender loris (*Loris tardigradus*) is found in Sri Lanka and South India, while the Slow loris (*Nycticebus coucang*) prefers the densest parts of tropical rainforests in eastern India, that includes Tripura.

Locally known as '*lajjawati banar*', the Slow loris is a very docile and shy animal that sleeps through the day, rolled up as a ball. During hot weather and at nights it stretches out on a branch. In appearance, it is lanky, with a brown streak on its crown and dark markings on its pale brown face. Subtropical and tropical

evergreen, semi-evergreen rainforests (up to 1300 m) are its most preferred habitats, with its preference for tree holes and bamboo groves. Its diet includes shoots, fruit, insects, reptiles and birds, in fact, anything it can lay its 'hands on'. It sucks leaf sap from the leaf petioles, thus heaps of petiole-less leaves under a tree indicate its presence. True to its English name, the Slow loris is very slow in its movements. When hunting insects it never springs, but catches them with a sudden lunge, never letting go of the branch on which it maintains a tenacious grip. The Slow loris is found in small family groups. It breeds all year round, and the female give birth every 12–18 months. The gestation period is about 190 days. Infants become sexually mature in 18–20 months. Under captive conditions it is reported to live up to 20 years.

Habitat destruction (even moderate felling/logging) is the main cause of concern for the conservation of this species. In Tripura and many places in the northeast, *jhum* cultivation is highly detrimental to its survival. It is included in the Schedule I(I) of the Wildlife (Protection) Amendment Act, 1991. Due to the lack of scientific studies on the ecology and conservation of this species, the IUCN Red Data Book has categorized this species as 'Data Deficient,' and the CITES has placed it in Appendix II.

Stump-tailed macaque (*Macaca arctoides*)

It was known as *Macaca speciosa* until 1976, when the present scientific name was given. There are 2 subspecies, namely, *M. a. arctoides* and *M. a. melanota*. The former is found in Tripura. Similar to other primates, this is also known by different local names in its distribution range. In Bengali, it is known as '*sinduri banar*'. If one is lucky, it can be sighted easily in Gumti Wildlife Sanctuary,



otherwise one may have to spend time searching for it.

The Stump-tailed macaque is terrestrial but spends a lot of time on trees as well. Just before day break, troops of up to 30 individuals head for their feeding grounds, and if there are any fig trees with ripe fruit, they will almost certainly be found there. They rest and groom during the afternoon, before descending for their last feeding bout in the evening till the roosting time. As group living macaques, they are very noisy at times, but are known to raid crops in absolute silence. They normally do not fear man. In fact, *Naga* tribes are said to be afraid of them, for they can be very ferocious and aggressive when made to run from their feeding grounds. Being mainly frugivorous (mainly fruit eating), they are likely to be affected adversely by habitat destruction and fragmentation that result in less plant species diversity. They would have less food species to choose from. They are also hunted both for food and as pests for '*Pan Jhum*', mostly in the Khasi Hills.

This species has been placed in Schedule II(1) of Wildlife (Protection) Act, 1972/1991, and Appendix to the CITES. The IUCN has ranked it as 'Vulnerable (VU A1(c)(d))'.

Pig-tailed macaque (*M. nemestrina*)

Four subspecies are reported, of which *M. nemestrina nemestrina* is found in Tripura, and is fairly common compared to the Stump-tailed macaque. These are found in almost all the major forested areas in the state and are easily seen in Sepahijala Wildlife Sanctuary. Locally it is also known as '*Sukar letch banar*' owing to its tail, which is short, dark reddish on top and carried half-erect like a pig's tail. It is one of the largest of the genus, with long

legs and an elongated muzzle. The Pig-tailed macaque inhabits the same forests as its Stump-tailed relative, but is more arboreal and keeps strictly to dense evergreen forests. Fruit and seeds constitute its main diet, while the animal prey (including nestling birds, insects, termite eggs, larvae) makes up for the second most important dietary component. Pig-tailed macaques tend to cover long distances in a day (average 1–3 km) for food. They are found in multi-male, multi-female groups, comprising about 20–45 individuals in a group. Lone adult males are also common (Sepahijala Wildlife Sanctuary). Breeding is reported every 2 years, and the gestation period is about 170 days.

The Pig-tailed macaque is one of the few monkey species found in the sub-continent, which faces a threat from human poachers. Certain *Naga* tribes seek its meat and it is in great demand in Southeast Asia for 'coconut picking'. This species is also in demand for HIV (AIDS Virus) research. Being frugivorous and a dietary specialist, it is much more susceptible to habitat destruction and fragmentation leading to the reduction in the availability of fruit crops round the year. This species is listed in the Schedule I of the Wildlife (Protection) Amendment Act, 1991, Appendix II of the CITES, and the Red Data Book of the IUCN has listed this species as 'Vulnerable (VU A1(c)(d))'.

Rhesus macaque (*M. mulatta*)

It is commonly known as '*lal-mukh banar*', and is one of the commonest commensal primate species, which can be seen with great ease both in the forested and human habitation areas. Four subspecies are reported, of which *M. mulatta mulatta* is found in Tripura, while the others are *M. m. mcMahonii*, *M. m. vestita*,



M. m. villosa. The species is found all over the state, but without any definite population estimate.

The Rhesus macaque is diurnal, mostly terrestrial, and lives in large multi-male groups. A group may comprise > 35 individuals, though in a commensal habitat the group size may even cross 150 individuals. A group normally comprises adult males, females, juveniles, and infants. The relationship between adult males ranges from peaceful and even co-operative to highly antagonistic, while females are quite tolerant of each other. Grooming forms a major part of their daily activities, but it is the relationship of juveniles, which is the most fascinating. Little play groups of 3–4 young individuals display a natural exuberance rarely seen in other animals.

Rhesus macaques are generalists in their dietary requirements and mostly feed on the ground and can survive any habitat type due to their versatility. More than 100 plant species have been reported as food species for this species, though the staple diet may vary with the type of habitat. They may travel up to 4–5 km to meet their feeding needs. About 45% of the total activity time in a given day is spent on the feeding activity. Under captive conditions the life span is reported to be about 30 years. The females give birth to offspring every one to two years depending upon the habitat conditions.

There is no immediate threat to their conservation status. They pose a pest problem to the human population. Habitat destruction, however, remains the prime cause for concern compared to the other primate species in the region.

The Rhesus macaque is listed in Schedule II of the Wildlife (Conservation) Act, 1972, and

Appendix II of the CITES. The IUCN has ranked it as 'Lower Risk LR 2(nr)' species.

Phayre's langur (*Trachypithecus phayrei*)

Phayre's langur, *Trachypithecus phayrei* (= *Presbytis phayrei*), belongs to the family Colobidae. Its previous synonyms are *Presbytis obscurus*. Three subspecies are identified, namely, *T. phayrei phayrei* (Bangladesh and India), *T. p. shanicus* (North Shan States and the area to the east of the river Irrawaddy in the dry zone of upper Myanmar), and *T. p. crepusculus* (central and southwest Thailand). *T. p. phayrei* is found in Tripura.

It is the 'State Animal' of Tripura. The most striking feature of this small, slender langur is a pale patch surrounding the mouth and eyes. White rings completely encircle the eyes, giving it an appearance of being bespectacled, hence it is commonly called *spectacled langur*, *chashma banar* or *dudhmukhi banar* in the local language. The shape and size of the white patches around the eyes differ in adult males and females. This ocular marking forms an easy tool in the identification of sexes, as in an adult male the white patches are almost circular or elliptical, whereas in an adult female these are almost triangular or cone-shaped. This difference in ocular marking is absent in neonates and infants. In neonates the face is uniformly pinkish brown without any differentiation around the eyes and lips. In infants of 6–7 months, the face colour starts changing into the adult colour (black), and at the same time the area surrounding the eyes and lips also starts turning white. Another distinguishing morphological feature is the presence of a tuft of hair as a longitudinal crest on the head.

In India, Phayre's langurs are confined to 3 northeastern states, the largest population



being in Tripura (Gupta, 1994). This species has also been reported recently from Assam (Choudhury, 1986) and Mizoram (Mishra *et al.*, unpublished report). In Assam and Mizoram, this species has been reported only from those areas (Cachar district in Assam and Dampa Wildlife Sanctuary in Mizoram) which are close to Tripura, and which were connected by dense evergreen forests in the recent past. Thus it seems highly probable that Phayre's langur groups might have migrated from Tripura to Assam and Mizoram in the recent past. Later, after the loss of those forestland connections, this migration stopped. In Assam, where primate surveys have been carried out all over the state (Choudhury, *pers.comm.*), no other population of Phayre's langur has been reported elsewhere, although the habitat is very similar. This, and the total absence of this species from other northeastern states, which had no land connections with Tripura, further confirm that the populations of Phayre's langur reported from Assam and Mizoram could have migrated from Tripura. It is surprising, though, that Manipur, Nagaland, Meghalaya and Arunachal Pradesh, falling in between the distribution range of this species that stretches from Bangladesh in the west to Thailand in the east, have no trace of this species.

In Tripura, Phayre's langurs are reported from all over the state, but more in the southern districts than in the western and northern districts (Mukherjee, 1982, Gupta 1994). Even within these districts their population is not distributed uniformly, but is concentrated in a few areas. In Tripura, they are sympatric with Capped langurs, Rhesus, Stump-tailed and Pig-tailed macaques, Slow loris and Hoolock gibbon (Gupta & Kumar, 1994). It inhabits a wide range of habitats, for example, dense natural patches of evergreen forests, semi-

evergreen forests, deciduous secondary forests of biotic origin (shifting cultivation, logging, clear felling, fire), and mixed forestry plantations of both timber and non-timber species, e.g., sal, garjan acacia, bahera, koroi, harish, radhachura, and so forth. The state has a vast area under rubber (*Hevea brasiliensis*) plantations, which these langurs share with Capped langurs. Of the 56 groups identified during the survey in 1989, most (46.4%) were recorded from secondary forests, followed by plantations (32.2%) and primary forests (21.4%) (Gupta, 1994).

The only authentic population status of the Phayre's langur, in its entire distribution range, is available from Tripura, India (Mukherjee, 1982; Gupta, 1994). In Bangladesh, Gittins & Akonda (1982) estimated the total population of *T. phayrei* at ca. 1,300. This species is considered seriously threatened in Myanmar, China, Vietnam, Thailand and Laos. No account of any systematic surveys and detailed studies on the ecology and conservation of this species is available. In Myanmar, the species is considered highly threatened due to extensive hunting around salt springs, to obtain its lime-induced gallstones (*bezor stones*) for medicinal purposes. Mukherjee (1982) counted 409 individuals in 36 groups from 3 partly surveyed districts in Tripura, with a very low population density (0.1 individuals/km²). Gupta (1994) conducted an extensive survey of primates in Tripura in 1989 and counted a total of 899 individuals from 56 groups (1.2 individuals/km²) in different parts of 3 districts. If the population figures from Sepahijala and Gumti Wildlife Sanctuaries are also added to the 1989 estimates, the total population is ca. 1000 individuals in the state (Gupta, 1996).

Phayre's langurs are arboreal and mainly folivores (leaf eating). They hardly descend to



the ground as all their needs are fulfilled on the treetops, but have been noted descending to the ground to feed, travel, and, negotiate the gaps in the tree canopy. They are extremely shy and take flight when approached. According to one study, they spend more than half their time feeding on leaves, and very little on fruit and other plant parts. In total, about 81 different plant species were used by a group in Sepahijala Wildlife Sanctuary, West Tripura for meeting their feeding needs *Albizia procera*, *A. stipulata*, *Acacia auriculiformis*, *Artocarpus chaplasha*, *A. lakoocha*, *Ficus racemosa*, *F. indica*, *F. bengalensis*, bamboo shoots, *Delonix regia* were identified as the main food trees (Gupta, 1996, 1998). They live in groups of 8–22 individuals comprising usually one adult male, 3–6 adult females, sub-adults, juveniles, and infants. Infants are born between November and March. The infants are golden brown in colour and mothers devote considerable time in rearing the infants. Adult males do not take any part in this act. Adult males let off 'kha kha kha' calls when alarmed, and as such there are 4 other different types of calls expressing different meanings in their social life. Each group normally has a definite home range, which is defended from other groups of the same species. The groups of other sympatric species, however, can use the same home range at the same time without any threat of conflict.

Eudey (1987) regarded this species as 'vulnerable' with a total conservation priority rating at '5'. This rating is based on various criteria, for example, degree of threat, taxonomic uniqueness, and association with other threatened primates. The degree of threat is proposed as 'vulnerable' for Phayre's langur. Since the total population of this species is far below 10,000 individuals, and is still on the decline

following habitat destruction, it may be appropriate to regard this species as 'endangered' or 'highly endangered'. In India, the conservation risk to this species has been recognized by placing it in the Schedule I of the Wildlife (Protection) Act, 1972/1991. The species shares this legal protection with the Hoolock gibbon, Capped langur, Golden langur, and Slow loris. It is placed in the Appendix II and IUCN has ranked it as 'Not Evaluated (NE)'.

In Tripura the state government has given this species further recognition by declaring it as the 'State Animal', and in establishing a wildlife protected area (Gumti Wildlife Sanctuary), specifically in recognition of the conservation risk to this species in the state.

Capped langur (*T. pileatus*)

This is locally known as '*Tupi (cap) banar (langur)*' as the crown hairs form a distinct black cap-like structure.

The Capped langur (*T. pileatus*, formerly known as *Presbytis pileata*) belongs to the family Colobidae. Based on the differences in the general body colour, size, and skull structure, 5 different subspecies are identified. Of these *T. pileatus durga* is found in Tripura, while the 4 subspecies are *T. p. pileatus*, *T. p. tenebricus*, *T. p. brahma*, and *T. p. shortridgei*.

However, in India these species are present in all 7 northeastern states unlike Phayre's langur. In Tripura, similar to the distribution of Phayre's langurs, Capped langurs are reported from all 3 districts (south, north, and west), but more in the south district (Mukherjee & Chakraborty, 1992 Gupta, 1994). In Tripura, Capped langurs are sympatric (sharing the same habitat) with 7 other primate species (including the introduced Golden langur group



in Sepahijala Wildlife Sanctuary, and occupy almost the same habitat as described for Phayre's langurs in the preceding section. Unlike Phayre's langurs, who were found more in secondary forests, the Capped langurs are reported more in primary forests (50%), than in secondary (30%), and plantation forests (20%) (Gupta, 1994).

In India, population estimates are available from Gharmura in Cachar district of Assam, where Choudhury (1989) encountered 10 groups with a total population of about 110 individuals. In Tripura, Mukherjee and Chakraborty (1992) documented 16 groups in 3 districts, with a total population of 108 individuals. Gupta (1994) counted 165 individuals from 30 groups (population density = 0.2 individuals/km²) of Capped langurs in 3 districts (Gupta 1994). In Gumti Wildlife Sanctuary, in an area of 0.66 km², the population density of 2 groups of Capped langur was 19.7 individuals/km², and in Sepahijala Wildlife Sanctuary, 18 groups were counted with a population density of 5.3 individuals/km² (Gupta, 1994). No authentic reports on the population status of this species are available from Arunachal Pradesh, Meghalaya, Manipur, Nagaland, and Mizoram.

Capped langurs prefer dry tropical forests and dense evergreen jungles. Only during the dry season do they leave the tree shade to drink. They are extremely shy, either taking flight through the trees or sitting absolutely still when approached. They are highly arboreal and live in groups of about 5 to more than 20 individuals, including one adult male, 3–4 adult females, juveniles, and infants. They are mainly folivorous (feeding on leaves), although unripe fruit and seeds also constitute their main diet. They are generalist feeders and can switch over to alternative diets in the absence

of regular diets. It is this feeding habit of Capped langurs, which has helped them survive drastic alterations in their habitat.

Eudey (1987) has placed this species with Phayre's langur in the Conservation Priority Ratings for Asian Primate Species, as a wide-ranging vulnerable species. Based on its limited distribution range, and present population status, this species, similar to Phayre's langurs, deserves to be also ranked as endangered or highly endangered. In India, habitat destruction has been identified as one main conservation risk to the Capped langurs. This species has been provided the highest legal protection, as it is included in Schedule I (1) of the Wildlife (Protection) Amendment Act, 1991, along with Phayre's langur. It is also placed in the Appendix I (rare and endangered) of the CITES. In the IUCN Red Data Book, it has been ranked as 'Vulnerable (VU A2(c))'.

Hoolock gibbon (*Bunopithecus hoolock*)

If one happens to visit Trishna or Gumti Wildlife Sanctuaries in Tripura early in the morning, one cannot miss the sweet 'olohho olohoo olohho' songs (whooping calls), which are sung by the only ape (tail-less monkey) species in India—the Hoolock gibbon. These songs have a definite meaning in the social life of this species, as the male gibbons advertise their territory by a solo performance, and the females sing duets with the males.

Gibbons inhabit dense evergreen forests, the less seasonal parts of semi-evergreen forests, and very rarely semi-deciduous forests. They are diurnal (active during the day and sleep by night), and arboreal (spending most of their activity time on treetops, rarely descending to the ground). Continuity in the tree canopies is a must for their special mode of



travel—brachiation (swinging from branch to branch using relatively long arms), therefore, gaps in the canopy are detrimental to their survival. They have small legs on which they run, sometimes along the boughs of trees. They live in a small family comprising one adult male, adult female, and 1–2 juveniles.

They mostly feed on ripe, sugar rich fruit and figs. Their animal diets include insects, bird eggs, and spiders (most preferred), which make up for about 4% of the total diet. The typical plant diet consists of fruit (> 60%), leaves (12%), and other plant parts making up for the remaining portion of the total time spent on feeding. Fig (bat) fruit is the most preferred plant diet. *Ficus* spp., *Artocarpus chaplasha*, *A. lakoocha*, *Mesua ferra*, *Castanopsis indica*, *Terminalia belerica*, *T. chebula*, *Emblica officinalis* are the major food plants.

The gibbon, like many of its order, is also facing a stiff challenge for survival, as pressure for land and timber mounts. Hunting for meat and other uses are the major threat to this species throughout its range. Legal protection has been provided to this species by placing it in Schedule I (1) of the Wildlife (Protection) Act, 1972, Appendix I of the CITES, and 'Endangered' category of the IUCN Red Data Book.

Conservation Issues

Pressures

Habitat Destruction

- Selective logging
- Clear felling
- Monoculture plantation of commercial species
- Conversion of forest into agriculture fields

- Permanent cultivation
- Shifting cultivation
- Diversion of forest habitat for urbanization, hydro-electric projects

Hunting/Poaching

Live-trapping

Agriculture-pests

Suggested Remedial Measures

- Habitat restoration—an ecosystem approach
- Basic data collection in population status, habitat use and demography
- Detailed long-term ecological studies
- Captive breeding
- Re-introduction
- Education & Awareness

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Status and Conservation of Non-Human Primates in India

R. P. Mukherjee



Species	Distribution		Status	Research Areas
	India	Outside India		
Slender loris (<i>Loris tardigradus</i>)	Forests of South India (parts of Tamil Nadu, Kerala, Karnataka and south Andhra Pradesh)	Sri Lanka	Status not known Nocturnal species Supposed to be common	
Slow loris (<i>Nycticebus coucang</i>)	North-east India	Bangladesh, Myanmar, Thailand, Malaysia, Indonesia, Philippines, Kampuchea, Vietnam, Laos, South China	Status not known Nocturnal species Wild population Seems to be good in its range	
Rhesus macaque (<i>Macaca mulatta</i>)	West, North, North-east and Central India. South beyond Godavari to Krishna delta	Northeast Afghanistan, Pakistan, China, Bhutan, Nepal, Bangladesh, Myanmar, Hong Kong, Kampuchea, Laos, Thailand, Vietnam, Tibet	Common ca. 3,00,000 to 3,50,000 in India	Abundance, Distribution, Ecology and Behaviour
Bonnet macaque (<i>M. radiata</i>)	Endemic to South India, south of Godavari to Krishna delta		Common Estimated to be ca. 1,50,000.	Taxonomy, Abundance, Distribution, Ecology and Behaviour
Assamese macaque (<i>M. assemensis</i>)	Darjeeling (West Bengal), Sikkim and Northeast India	Bhutan, northern Myanmar, South China, Nepal, Bangladesh, Kampuchea, Laos, Thailand, Vietnam	Rare in India	Taxonomy, Abundance, Distribution, Ecology and Behaviour
Pig-tailed macaque (<i>M. nemestrina</i>)	Northeast India	South China, Bangladesh, Myanmar, Indonesia (except Java), Kampuchea, southern Laos, Malaysia, Thailand, southern Vietnam	Rare, estimated to be around 2,000–2,500 in India	Taxonomy, Abundance and Distribution
Stump-tailed macaque (<i>M. arctoides</i>)	Northeast India	South China, Tibet, Myanmar, Thailand, eastern Bangladesh, Laos, Kampuchea, Malaysia, Vietnam	Rare, population less than Pig-tailed macaque	Abundance and Distribution
Crab-eating macaque (<i>M. fascicularis</i>)	Nicobar Islands	Myanmar, Indonesia, Kampuchea, Malaysia, Philippines, Thailand, Bangladesh, Vietnam	NA	Distribution and Social status

Species	Distribution		Status	Research Areas
	India	Outside India		
Lion-tailed macaque (<i>M. silenus</i>)	Endemic to South India (Western Ghats between N.A. workers latitudes 9°30 and 15°N)	N.A.	Rare, estimates differ between workers	Taxonomy, Abundance, Distribution, Ecology and Behaviour
Hanuman langur (<i>Semnopithecus entellus</i>)	Whole of India, except Northeast India	Bhutan, Bangladesh, Nepal, China, Pakistan, Sri Lanka	Common, Appro. 3,00,000 in India	Social organization, Abundance, Distribution, Ecology and Behaviour
Phayre's langur (<i>Trachypithecus phayrei</i>)	Tripura, south Cachar in Assam and eastern Mizoram	Bangladesh, Myanmar, Thailand, China, Laos, Vietnam	NA	Social organization, Abundance, Distribution, Ecology, Taxonomy and Behaviour
Capped Langur (<i>T. pileatus</i>)	Northeast India	Bangladesh, Myanmar	NA	Taxonomy, Social organization, Abundance, Distribution, Ecology, and Behaviour
Golden Langur (<i>T. geei</i>)	Western Assam (between Saukose and Manas rivers) introduced in Sepahijala and Trishna Wildlife Sancturies	Southern Bhutan, adjacent to western Assam	Rare	Taxonomy, Social organization, Abundance, Distribution, Ecology, and Behaviour
Nilgiri Langur (<i>T. johnii</i>)	Endemic to South India (Western Ghats south of Coorg; Karnataka, Nilgiris and Palni and Anamalai Hills; Tamil Nadu and Cardamom Hills in Kerala)	N.A.	Rare and threatened.	Taxonomy, Social structure, Abundance, Distribution, Ecology, and Behaviour
Hoolock Gibbon (<i>Bunopithecus hoolock</i>)	Northeast India (south and east Brahmaputra and Lohit rivers)	Eastern Bangladesh, South China, northern Myanmar	Threatened	Social structure, Abundance, Distribution, Ecology, and Behaviour



Problems of Prioritizing Primate Species for Captive Breeding in Indian Zoos

Sally Walker & Sanjay Molur



Introduction

All over the world, captive breeding in zoological gardens, parks, and other similar facilities has been undertaken as a conservation tool. In India there is even a National Zoo Policy which states that 'the main objective of the zoos shall be to complement and strengthen the national efforts in conservation of the rich biodiversity of the country, particularly the wild fauna ...' Supporting the conservation of endangered species by giving species, which have no chance of survival in the wild, a last chance of survival through coordinated breeding under *ex situ* conditions and raise stocks for rehabilitating them in the wild as and when it is appropriate and desirable' (CZA 1998). The Zoo Act itself states that 'All zoos shall participate in planned breeding programme of endangered species approved by the Central Zoo Authority in consultation with the Chief Wildlife Warden of the State. For this purpose, they shall exchange animals between zoos, by way of breeding loans, gifts etc. as per the directions of the Central Zoo Authority' (Gazette of India, 2001).

Article 9 (*Ex situ* conservation) of the Convention on Biodiversity calls upon each party to a) adopt measures for the *ex-situ* conservation of components of biological diversity, prefer-

Abstract

Captive breeding is a recognized conservation tool all over the world. In India there are over 180 public zoos, mini-zoos and deer parks holding animals, 97 of which hold 1753 individual Indian primates (CZA in litt.). Of the 14 species listed by the Central Zoo Authority in 2002, 7 species are threatened globally, 4 non-threatened and 3 Data Deficient (Hilton-Taylor, 2000); 3 are endemic to India.

Since appropriate, high-quality captive space and programme resources are limited, well-managed zoos in India must prioritize threatened and endemic species for conservation breeding, including newly designated species and subspecies under the recently revised taxonomy, which are endemic to India and even to small areas in India. The need for identification and prioritization has assumed great importance in the light of the recent taxonomic modifications within Asian primates and the increasing pressure on stressed habitats. This paper will focus on the revised taxonomy and the difficulties facing the zoo community in India as these new scientific investigations evolve.

ably in the country of origin, b) establish and maintain facilities for *ex situ* conservation of and research on plants, animals and micro-organisms, preferably in the country of origin

of genetic resources, c) adopt measures for the recovery and rehabilitation of threatened species and for their reintroduction into their natural habitats under appropriate conditions and d) regulate and manage collection of biological resources from natural habitats for *ex situ* conservation purposes so as not to threaten ecosystems and *in situ* populations of species, except where special temporary *ex situ* measures are required (UNEP, 1994).

The World Zoo Conservation Strategy, states, 'Zoos can contribute directly to preventing of extinction of endangered species. *Ex situ* zoo populations can directly support the *in situ* survival of some species by providing the nucleus for re-establishment or reinforcement of wild populations in nature' (IUDZG/CBSG (IUCN, SSC 1993).

The IUCN Policy Statement (1987) on Captive Breeding, states that 'Establishment of self-sustaining captive populations and other supportive intervention will be needed to avoid the loss of many species, especially those at high risk in greatly reduced, highly fragmented, and disturbed habitats. Captive breeding programmes need to be established before species are reduced to critically low numbers, and thereafter need to be co-ordinated internationally according to sound biological principles, with a view to the maintaining or re-establishment of viable populations in the wild' (IUCN, SSC, CBSG 1987). The current Draft Statement, the IUCN Policy on the Management of *Ex Situ* Populations for Conservation, the final version of which will be ratified by IUCN in due course is even more specific: '... in some regions the threats to taxon survival are so severe that no hope exists for their long-term *in situ* maintenance. ... we shall be unable to ensure the survival of an increasing number of threatened taxa without effectively utilizing a

diverse range of complementary conservation approaches and techniques including, for some taxa, increasing the role and practical use of *ex situ* techniques' (IUCN SSC CBSG, in draft).

Therefore, although zoos were not—either in India or anywhere in the world—created initially to save species, this is their stated goal today in most countries and in most important global documents. The role of research and education in *ex situ* facilities in strengthening *in situ* efforts is also given due importance. The conservation community at large is convinced that *ex situ* conservation is a valid conservation tool.

Indian Primates

Of the 14 species listed by the Central Zoo Authority in 2002 which uses the old taxonomy, 7 species are threatened globally, 4 non-threatened and 3 Data Deficient (Hilton-Taylor, 2000). 3 are endemic to India. *Trachypithecus phayrei*, Phayre's leaf monkey, (held by Sepahijala Zoological park but not in the CZA database) makes a total of 15 primates with distribution in India held in Indian zoos.

Many changes in taxonomy and nomenclature (combined with one new distribution—for *Macaca thibetana*) have been published recently which effectively increases the number of species from 15 to 21 and the number of subspecies to 12. Also, the changes effectively create 3 more endemic species for India: *Semnopithecus dussumieri*, *Semnopithecus hypoleucos*, and *Semnopithecus priam* (Groves, 2001).

Most primate species distributed in India are represented in the Indian zoos in varying numbers and sex ratios (CZA, 2002). Although, the Indian zoo community has formulated



breeding strategies involving systematic exchanges between zoos since 1982 (Walker 2000), these strategies have been created largely without system, science or objectivity. Although Indian zoo authorities are enjoined by legislation to participate in planned breeding programmes of endangered species approved by CZA and to exchange animals between zoos by direction of CZA, they are not, even now, suitably empowered practically and administratively to follow these strategies. State and municipal governmental officials, who control the zoos, change frequently and do not always comprehend the subtle requirements of zoos, including the importance of cooperation between them.

Until recently, it could be said quite confidently that certain primates, such as the Common langur, Rhesus macaque, and Bonnet macaque do not require a captive breeding programme as their numbers and distribution in the wild are sufficient, even over-abundant in some instances. In the last few years, however, scientific information about some primate species has led to a revision in primate taxonomy which has split certain primate species either into multiple species or into subspecies, depending on the taxonomic interpretation. The Common langur, for example, has been defined as 7 distinct species (Groves, 2001) or 9 distinct subspecies (Brandon-Jones *et al.*, 2002, unpub.) each of which are not common at all.

In 2000 a workshop organized by the IUCN SSC Primate Specialist Group reviewed the then current taxonomy in the context of other publications and generated the new primate taxonomy with a number of new subspecies. In 2001, Colin Groves' book, *Primate Taxonomy* was published which designated new species, some of which are upgrades of the new subspecies. Since then the 2000 paper

(Brandon-Jones, *et al.*, 2000, unpub) has been revised and is undergoing further revision (Brandon-Jones *et al.*, 2002, unpub.) The Brandon-Jones 2002 taxonomy was selected for use by participants of a Conservation Assessment and Management Plan (CAMP) Workshop for South Asian Primates held in Coimbatore, India in March 2002. Their input may lead to further refinement of the paper as the author also attended the workshop. This is the way of taxonomy, which seems both friend and foe for the wildlife field scientist and zoo biologist!

As mentioned earlier, 7 species of the Common langur, *Semnopithecus entellus* have been identified by Groves. These are, illustrated in Table 1. (Groves is used as the yardstick in this paper because it is the most recently published taxonomy.) In the 2000 and 2002 unpublished papers by Brandon-Jones *et al.*, Groves' species are designated as subspecies. Whatever the differences between recent publications and papers, the names and taxonomic status of several primates definitely has changed. Whether they are species or subspecies does not change the fact that they are distinct populations, and ignoring that is not now a viable option for any scientist or scientific institution. The Convention on Biodiversity gives importance to subspecies and species, and *ex situ* solutions may be the last solutions for some.

In terms of prioritizing the *Semnopithecus* for captive breeding also, it makes no difference whether they are species or subspecies, but it very effectively demonstrates the increasing complexity involved in conservation planning. What does the zoo community do in such instances? Scientific evidence cannot be ignored, yet the implications of dealing with the changes are formidable.



Table 1: Taxonomic and Nomenclature Changes in Indian Primates

CZA Database	Scientific Name after Groves, 2001
<i>Macaca fascicularis umbrosa</i>	<i>Macaca fascicularis umbrosa</i>
<i>Trachypithecus geei</i>	<i>Trachypithecus geei</i>
<i>Hylobates hoolock</i>	<i>Hylobates</i> (? <i>Bunoihtecus</i>) <i>hoolock hoolock</i> (Harlan, 1834) Nominate subspecies in India
<i>Macaca silenus</i>	<i>Maaca silenus</i>
<i>Trachypithecus phayrei</i>	<i>Trachypithecus phayrei phayrei</i> Nominate subspecies in India
<i>Trachypithecus johnii</i>	<i>Trachypithecus johnii</i>
<i>Loris tardigradus</i>	New name for Indian population <i>Loris lydekkerianus</i> with two subspecies: <i>Loris lydekkerianus lydekkerianus</i> (Cabrera, 1908) <i>Loris lydekkerianus malabaricus</i> (Wroughton, 1917)
<i>Macaca speciosa</i>	Name change: <i>Macaca arctoides</i>
<i>Macaca assamensis</i>	Two subspecies added: <i>Macaca assamensis assamensis</i> (McClelland, 1839) <i>Macaca assamensis pelops</i> (Hodgson, 1840)
<i>Nycticebus coucang</i>	<i>Nycticebus bengalensis</i> (Lacépède, 1800)
<i>Trachypithecus pileatus</i>	Four subspecies added: <i>Trachypithecus pileatus pileatus</i> (Blyth, 1943) Capped langur <i>Trachypithecus pileatus brahma</i> (Wroughton, 1916) Capped Langur <i>Trachypithecus pileatus durga</i> (Wroughton, 1916) Capped Langur <i>Trachypithecus pileatus tenebricus</i> (Hinton, 1923) Capped Langur
<i>Macaca Mulatta</i>	<i>Macaca mulatta</i>
<i>Macaca radiata</i>	<i>Maca radiata radiata</i> (E. Geoffroy, 1812) <i>Macaca radiata diluta</i> (Pocock, 1931)
<i>Semnopithecus entellus</i>	Seven species instead of one: <i>Semnopithecus entellus entellus</i> (Dufresne, 1797) <i>Semnopithecus entellus</i> Subspecies <i>Semnopithecus ajax</i> (Pocock, 1928) <i>Semnopithecus dussumieri</i> (I. Geoffroy, 1843) <i>Semnopithecus hector</i> (Pocock, 1928) <i>Semnopithecus hypoleucos</i> (Blyth, 1841) <i>Semnopithecus priam</i> (Blyth, 1844r) <i>Semnopithecus schistaceus</i> (Hodgson, 1840)
<i>Macaca nemestrina</i>	<i>Macaca leonina</i> (Blyth, 1863)
(not listed by CZA)	<i>Macaca thibetana</i> (Milne-Edwards, 1870)

Groves, Colin (2001) *Primate Taxonomy*, Smithsonian Institution, 348 pp.



The IUCN SSC Red List Committee used the unpublished 2000 paper in the 2000 Red List of Threatened Animals. In terms of assessment also, it doesn't make a difference whether these are species or subspecies—they are different populations and it is the genetic diversity in different populations that

wants conserving. The population status as derived according to IUCN Red List Criteria is interesting.

These *Semnopithecus entellus* populations, if you will, were categorized as either Lower risk-near threatened or Data Deficient (IUCN Red List, 2000). According to the IUCN Policy

Statement on Captive Breeding, the time to start a captive breeding programme is before the wild population reaches very low numbers. Already, 4 of these were assessed as Lower risk-near threatened which means that they are 'close to qualifying for Vulnerable', a threatened category. Therefore, according to the IUCN Red List, 2000, the time to think of captive or conservation breeding is at hand.

However, in the 2002 CAMP Workshop with over 40 currently working South Asian primate field biologists all contributing very specific information, most of these populations were upgraded to threatened categories. The output of this workshop has yet to appear in its final form but there is scant reason to suspect that there will be many significant changes in the categories just derived. Therefore, the time to think of conservation breeding for most of these species actually is much overdue!

If the zoo community ignores new species or subspecies, it runs the risk of losing scientific credibility, a commodity that it has yet even to earn in the eyes of many critics. In years to come, ignoring these changes could result actually in the failure of reintroductions and the loss of an endemic species or subspecies for the country. For example, subspecies evolve as a result of conditions of the area in which they live. Some subspecies within a species come from very different habitat conditions which would affect their survival. For example, the Slender loris, in India formerly designated as *Loris tardigradus*, is now *Loris lydekkerianus lydekkerianus* which is distributed in lowland dry forests, and *Loris lydekkerianus malabaricus* which inhabits the Western Ghats wet forests. Trying to reintroduce either of these into the other's habitat not only poses risks of polluting the gene pool but also poses a risk for their well-being and survival.

It is as inappropriate as releasing the hard ground barasingha (*Cervus duvaucelli duvaucelli*) into the swamps of the wet ground barasingha (*Cervus duvaucelli branderi*).

The alternative that is now attempting to identify zoo holdings precisely by the revised taxonomy and start captive programmes for all taxa which require it, will create an overwhelming set of new initiatives, and requirements for additional expertise, housing, staff, and equipment, and daunting expenses. This is a particularly bitter pill to swallow in the light of the ever present possibility of a return to some of the earlier systems over the passage of years and further advancement of taxonomic knowledge!

In this paper, the Central Zoo Authority inventory of primates has been contrasted with recent changes in nomenclature and taxonomy with an eye to point out the pitfalls of ignoring the issues created by these changes. Providing solutions to such problems is the mandate of the Central Zoo Authority and the sooner zoo policy-makers and strategists put their minds to these concerns, the better. Indian zoos are just now beginning to sex their animals and keep accurate, viable records, so the sorting out of subspecies and hybrids and the creation of a policy and strategy for addressing these issues will be vexing indeed.

Basic Management vis-à-vis New Initiatives

Thinking that the creation of new initiatives to deal with the complexities of the revised taxonomy is only part of the problem. In fact, one of the first things that will be required is simply to insure that basic management principles are followed more efficiently.

For example, there has been a long-standing



need to curtail breeding of common species in zoos, considered so important that it has been included both in the National Zoo Policy as well as zoo legislation in India. Now, given the recent taxonomic revisions, the need to curtail breeding of certain species is even more crucial because there is a danger of hybridization. The space and resource requirement for breeding programmes as opposed to just exhibition are much more when breeding multiple species. There will be scant space or resource to spend simply housing carelessly bred or acquired animals. Fortunately, large numbers are not required for maintenance of genetic diversity or conservation in *ex situ* populations if they are scientifically managed. Basic management and Indian zoo legislation and policy also requires that zoos refrain from overbreeding, inbreeding, and cross-breeding wild animals (CZA, 1998). More recent legislation requires that zoos manage their breeding programmes according to scientific standards (Anon., 2001).

Another basic zoo management task is keeping accurate and detailed records of the origin of individual animals, also reinforced by both policy and legislation in India. The increased knowledge of species as related to distinct habitat areas or even niches and its application in the taxonomic revisions has reinforced the existing requirement for the origin of each individual. It is not enough to know that the animal came from a particular zoo, or even a particular state. Now, in each and every instance, it is necessary to know a more specific locality at a fine scale as well as the habitat in this locality. Upgrading current records will be a mammoth and in some instances almost an impossible task. At the very least, however, this information could be obtained relatively easily for recently acquired animals if the zoos

are appropriately informed and take care keep themselves informed.

Marking or permanent identification of individual animals, a requirement of good zoos for at least 3 decades now, but still not done in all the better Indian zoos, is now, even more essential to maintain the identity and the provenance of each animal, as well as its sex and age.

Other examples can be illustrated species by species. In the examples below, figures for zoo populations will be given separately for 'Large, Medium, and Small' zoos (LMS zoos) and for 'Mini-Zoos and Deer Parks (MZDPs). This is a device for ranking zoos adopted by the Central Zoo Authority (Anon., 1992). Data for the LMS zoos is current, from the CZA database 2002. Data for the MZDPs is from the 1999 database as data for MZDPs is not updated with the same regularity as for the better zoos. In view of some of the taxonomic revisions, this practice may require a re-visit by the CZA. Some threatened or near-threatened species, once thought to be common may be languishing in MZDPs. They should be moved to LMS zoos and carefully monitored.

Common langur

The Common langur, *Semnopithecus entellus*, can no longer be called as such appropriately. There are at least 7 species where formerly there was one. Common langurs can be found in 25 LMS zoos and in 13 MZDP, totally 38 facilities throughout India. The Common langur that we are accustomed to is already in plenty with a zoo population of 59.37.5.102 in LMS zoos and 21.14.12.47 in MZDPs, a total of 149 individuals. However, it is safe to assume that some of these 149 individuals belong to more than one of the now 7 species,



as they originate from and are maintained throughout the length and breadth of India. Therefore, instead of zoos holding 149 individuals of the same species that are abundant in nature, they are very likely holding a number of individuals of different threatened species and subspecies. In the recent CAMP Workshop all but one of these different populations of the Common langur were assessed as threatened.

Moreover, identification of these recently designated species depends for the time being on knowledge of their origin, another basic management requirement. In future it may be possible to identify some of them on the basis of their pelage (a rough key is being created by Dr Douglas Brandon-Jones specifically for this purpose) or by DNA fingerprinting under the CZA project with the Centre for Cellular and Molecular Biology (CCMB). However, establishing the provenance even of high profile animals such as tigers and lions has been a nightmare in the Indian zoo community, so collection of reliable information about the origin of every Common langur will demand a quantum leap in commitment to conservation from the zoo community.

Moreover, as exchanges and movement of the Common langur has taken place between zoos in different parts of the country, widespread hybridization is possible. We asked Dr Colin Groves what Indian zoos should do to address the changes under such circumstances and his recommendations were:

- Find out which really are hybrids; trace their actual origin, where they were caught in the wild, and their genealogies as far as possible.
- Try to keep the different breeding groups separate until it has been determined which

are conspecific (and, if possible, which are consubspecific).

- The hybrids can be retained for display but should not be mixed with the 'pure' gene-pools. (Hybrids have uses even for research, e.g., inheritance of species-specific differences, not least in behaviour).
- When background information (including status in the wild) has been collected, known hybrids can be sterilized (Groves, in litt.).

Rhesus macaque

The Rhesus macaque (*Macaca mulatta*) is one of the most numerous of primate species in Indian zoos; it is held in 44 LMS zoos (196.201.75.472) and 31 MZDPs (24.23.54.101) with a total number of 573 individuals (CZA in litt.). The Rhesus macaque is considered a pest in some areas due to its large numbers in the wild, its adaptation to and invasion of towns and cities, and its aggressive nature. Groves (2001) recognizes 3 subspecies of the Rhesus macaque: *Macaca mulatta mulatta* which is found in India, Nepal, Bhutan and Burma; *Macaca mulatta villosa* which is found in India in Southern Kashmir, Northern Punjab and Kumaon; and *Macaca mulatta vestita* distributed in India in Khafristan and Chitral. The relative value of subspecies varies from scientist to scientist but the Convention on Biodiversity includes both species and subspecies in its mandate. If every species and subspecies is intrinsically and potentially valuable, it is not wise for zoos to ignore subspecies. In the case of the Rhesus macaque, a captive breeding programme may not be necessary, even under the revised taxonomy, but a programme of not breeding these taxa is most certainly advisable until the identification of subspecies and indeed,



their validity, can be undertaken. Not breeding Rhesus macaques in zoos was a good idea even before the taxonomic revision; now it is an exceptionally good idea!

Bonnet macaque

The Bonnet macaque, formerly *Macaca radiata*, is now *Macaca radiata radiata* found only in India, south to Palni Hills, southeast as far as Tenmali, inland of Pondicherry, and *Macaca radiata diluta* distributed only in India in southeastern coast to the southern tip, north of Kambarn (southwestern foot of Palni Hills) and east of Pondicherry (Groves, 2001). The Bonnet macaque can compete with the Rhesus macaque in numbers with 244.200.163.607 in 35 LMS Zoos and 27.18.41.86 in 31 MZDPs, with a total of 46 zoos and 693 individual animals. What was said of the Rhesus macaque (above) regarding captive breeding, is equally true of the Bonnet macaque. Neither figured under the threatened category when assessed in the recent workshop but *Macaca radiata diluta* was assessed as Near threatened.

Slender loris

What was called *Loris tardigradus* in India is now called *Loris lydekkerianus*. It is found in both India and Sri Lanka. In India there are 2 subspecies distributed in two different habitat types, as mentioned earlier. Only three LMS zoos hold this species with 4.0.1.5 individuals. The fact that there are so few Slender loris in so few zoos today when a virtual multitude of them have been passed to zoos from animal dealers, confiscations, etc. over the years (Walker, pers. observation) is indicative of the fragility of this animal and its need for appropriate climate and surroundings. At least, if the origin of current holdings can be traced and

correctly identified, then future acquisitions from rescues or confiscations will not be difficult to trace and place.

Capped langur

The Capped langur is listed as *Presbytis pileatus* in the CZA database but is now named as *Trachypithecus pileatus*. There are currently 4 subspecies of *Trachypithecus pileatus*, *Trachypithecus pileatus pileatus*, *Trachypithecus pileatus brahma*, *Trachypithecus pileatus durga* which are distributed within the north-western limit of the Indo-Burmese hotspot (Groves, 1991).

All of the subspecies of *Trachypithecus pileatus* have been categorized as Endangered in the IUCN List 2000, due to population decline of more than 50% in the past and the continuing decline and small population number. In the 2002 CAMP, 3 were categorized as threatened and one as Data Deficient.

Currently 14 LMS zoos hold 9.7.0.16 Capped langurs for which subspecies have not been identified as yet. These zoos span the length and breadth of India and even when classified as one species, care should be taken to insure that these animals are kept in zoos located in areas at least somewhat similar to their home range. It is interesting to note that of the 14 zoos, 12 hold single animals, 7 zoos hold single males, 5 zoos hold single females and only 2 zoos hold pairs (CZA 2002 in litt.). Before the issue of revised taxonomy came along, one might have bemoaned this sad state of affairs as it is normally a disgrace for a zoo to hold single animals. Now, however, it is a blessing until the Indian zoo community identifies these subspecies. For the welfare of the animals, at least, one would hope that zoos could put more of them together even



in adjoining cages, simply for the sake of satisfying the behavioural needs of highly social primates.

Assamese macaque

Macaca assamensis is now 2 subspecies instead of 1 species. *Macaca assamensis assamensis* is found in India, north along Dihang or middle Brahmaputra and *Macaca assamensis pelops* is found in Central Nepal and Sikkim in India, northernmost West Bengal and the Sunderbans. It is numerous in zoos although not as much as the 2 above-mentioned macaques. There are 52.37.10.99 in 12 LMS zoos and 5.3.4.12 in 5 MZDPs, a total of 111 animals (CZA 2002 in litt.). Both *Macaca assamensis* have been categorized Vulnerable in the IUCN Red List 2000, and as Endangered in the 2002 CAMP workshop therefore, sorting out its fate with regard to the different subspecies should be a higher priority than for the other macaques with very numerous species in zoos.

The taxonomy of other species of primates in Indian zoos, e.g. Slow loris, *Nycticebus bengalensis*, Hoolock Gibbon, *Hylobates* (?*Bunopithecus*) *hoolock hoolock*; Golden langur, *Trachypithecus geei*, Nilgiri langur, *Trachypithecus johnii*, Crab-eating macaque *Macaca fascicularis umbrosa*, Pig-tailed macaque, *Macaca leonine*; Stump-tailed macaque, *Macaca arctoides*; and Phayre's leaf monkey, *Trachypithecus phayrei phayrei*, has not been affected by the recent revisions and, thus, have not been discussed.

Conclusion

The Central Zoo Authority has made a mammoth effort to bring science and system into the zoo community, which has cost a great deal

of money. For so many reasons, the Indian zoo community still falls very short of the quality required to be conservation relevant. Since the inception of the Central Zoo Authority, the government has under-estimated the size of the task and the degree of expertise required to achieve even a small success.

One of the reasons for this sluggish progress in Indian zoo-dom is the need to please so many different groups of people, the international zoo community with its advanced technology, the lakhs of visitors with their recreational requirements, the animal welfare community with their often fanatical obsession with individual animals at the expense of populations and conservation goals, the scientific and conservation community which can be simply formidable in their criticism and inability to understand the difficulties of running a public facility as required of a scientific institution, *ad infinitum*. Many of those communities are not going to care a whit for the question of subspecies and others will demand nothing short of perfection.

In the end, it may not be possible for the zoo community, with its imminently public agenda, to achieve the level of detail required for genuine conservation at the levels required. In the past, however, other departments have tried to take on the task of breeding threatened species, and failed far more miserably than zoos. The Central Zoo Authority has taken the first steps towards transforming zoos into genuine conservation organizations, e.g. legislation, studbooks, and the creation of a Conservation Centre for biotechnology and related conservation sciences. The direction is correct but the scope and speed of change is far too slow to meet the needs of species and subspecies in the next few decades. Taxonomic revisions are not likely to become simpler. More people are taking up wildlife studies



seriously and the more they study species in their habitats, the more they report how subtle and delicate are species, subspecies and ecosystems. Indian zoos, in fact, could have played a very useful role in solving taxonomic issues in the recent CAMP workshop had their records been well maintained. The Indian zoo community can strive to be ready to play this role in the South Asian Primate CAMP Review which will take place in about 5 years.

Those who believe in the basic tenets of biodiversity, that every species and subspecies is actually and potentially valuable, must assist the zoo and wildlife community in making a case for sufficient establishment for a meeting these crucial needs.

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**Table 2. Degree of Endemicity
Indian Primates with Political Distribution and Assigned Value**

Scientific	# Value	Political Distribution
<i>Macaca silenus</i> Lion-tailed macaque	1	W. Ghats, Kerala, Karnataka, Tamil Nadu
<i>Trachypithecus johnii</i> Nilgiri langur	1	W. Ghats—Kerala, Tamil Nadu, Karnataka up to Coorg Hills
<i>Macaca radiata</i> Bonnet macaque	1	Peninsular India up to 21°N
Endemic to South Asia		
<i>Hylobates hoolock</i> Hoolock gibbon	2	India (Assam, Arunachal Pradesh, Meghalaya, Tripura, Mizoram, Northeast India). Myanmar and Bangladesh
<i>Trachypithecus geei</i> Golden langur	2	India (Assam and Bhutan)
<i>Semnopithecus entellus</i> Common langur	2	India (Throughout India except western part of Gujarat), Pakistan, Sri Lanka, Nepal
<i>Loris tardigradus</i> Slender loris	2	India and Sri Lanka
<i>Trachypithecus pileatus</i> Capped langur	2	India (Assam, Meghalaya, Nagaland, Arunachal Pradesh), Bangladesh, and Myanmar
Endemic to Asia		
<i>Macaca fascicularis umbrosa</i> Crab-eating macaque	3	India (Andaman & Nicobar Islands), Myanmar, Sumatra, Java, Borneo, Philippines, Vietnam to Malaysia
<i>Macaca nemestrina</i> Pig-tailed macaque	3	India (Meghalaya, Nagaland, Tripura); Southeast Asia up to Bornea
<i>Trachypithecus phayrei</i> Phayre's langur	3	India (Northeast) Bangladesh, Myanmar, Southeast Asia, China
<i>Macaca mulatta</i> Rhesus macaque	3	India (Whole of northern India [North of Godavari] up to Assam), Myanmar, Indochina
<i>Macaca arctoides</i> Stump-tailed macaque	3	India (Nagaland, Arunachal Pradesh, Meghalaya, parts of Assam, Tripura) China, Tibet, Myanmar, Thailand
<i>Macaca assamensis</i> Assamese macaque	3	Northeastern India (Himalaya from Mussori eastward to hills of Assam and forests of Arunachal Pradesh), Myanmar, Bangladesh, Southeast Asia
<i>Nycticebus coucang</i> Slow loris	3	India (Northeastern India), Myanmar, Bangladesh, Southeast Asia



**Table 3. Threat Status assessed at National Level
Indian Primates and Assigned Value**

Name	Status	Value	Status Description
<i>Macaca fascicularis umbrosa</i>	CR/N	1	A taxon is Critically Endangered when it is facing an extremely high risk of extinction in the wild in the immediate future, as defined by any of the criteria (A to E).
<i>Trachypithecus geei</i>	CR/N	2	
<i>Hylobates hoolock</i>	EN/N	2	A taxon is Endangered when it is not Critically Endangered but is facing a very high risk of extinction in the wild in the near future, as defined by any of the criteria (A to E) in the subsequent pages.
<i>Macaca silenus</i>	EN	2	
<i>Trachypithecus phayrei</i>	EN/N	2	
<i>Trachypithecus johnii</i>	VU	3	A taxon is Vulnerable when it is not Critically Endangered or Endangered but is facing a high risk of extinction in the wild in the medium-term future, as defined by any of the criteria (A to E).
<i>Loris tardigradus</i>	LRnt/N	4	Lower Risk Near Threatened: Taxa which do not qualify for any of the threat categories but are close to being threatened.
<i>Macaca arctoides</i>	LRnt/N	4	
<i>Macaca assamensis</i>	LRnt/N	4	
<i>Nycticebus coucang</i>	LRnt/N	4	
<i>Trachypithecus pileatus</i>	LRnt/N	4	
<i>Macaca mulatta</i>	LRlc/N	5	Lower Risk Least Concern: Taxa which do not qualify for near threatened.
<i>Macaca radiata</i>	LRlc	5	
<i>Semnopithecus entellus</i>	LRlc/N	5	
<i>Macaca nemestrina</i>	DD/N	3	Data Deficient: Taxa for which there is inadequate information to make a direct, or indirect, assessment of its risk of extinction based on distribution and/or population status. It may be well studied, and its biology well known, but appropriate data on abundance and/or distribution is lacking. Not a category of threat or Lower risk.

Name	Threat Status	+	Endemicity	
<i>Macaca fascicularis umbrosa</i>	CR (N) (1)	+	Asia (3)	4
<i>Trachypithecus geei</i>	CR (N) (1)	+	South Asia (2)	3
<i>Hylobates hoolock</i>	EN (N) (2)	+	South Asia (2)	4
<i>Macaca silenus</i>	EN (2)	+	India (1)	3
<i>Trachypithecus phayrei</i>	EN (N) (2)	+	Asia (3)	5
<i>Trachypithecus johnii</i>	VU (3)	+	India (1)	4
<i>Loris tardigradus</i>	LRnt (N) (4)	+	South Asia (2)	6
<i>Macaca arctoides</i>	LRnt (N) (4)	+	Asia (3)	7
<i>Macaca assamensis</i>	LRnt (N) (4)	+	Asia (3)	7
<i>Nycticebus coucang</i>	LRnt (N) (4)	+	Asia (3)	7
<i>Trachypithecus pileatus</i>	LRnt (N) (4)	+	South Asia (2)	6
<i>Macaca mulatta</i>	LRlc (N) (5)	+	Asia (3)	8
<i>Macaca radiata</i>	LRlc (5)	+	India (1)	6
<i>Semnopithecus entellus</i>	LRlc (N) (5)	+	South Asia (2)	7
<i>Macaca nemestrina</i>	DD (N) (3)	+	Asia (3)	6



Table 4. Illustrating Inverse Relationship between Number of Animals in Captivity & Requirement for Captive Breeding according to Endemicity and Degree of Threat

Species	Number of Animals of Each Species in Indian Zoos			Number of Zoos Holding	Priority Ranking for Captive pgm
	M	F	U		
<i>Macaca mulatta</i>	204	176	83	463	76
<i>Macaca radiata</i>	152	94	186	432	44
<i>Semnopithecus entellus</i>	78	56	19	153	36
<i>Macaca silenus</i>	34	34	06	74	22
<i>Macaca assamensis</i>	44	24	06	74	17
<i>Macaca arctoides</i>	23	18	00	41	14
<i>Trachypithecus pileatus</i>	12	04	00	26	15
<i>Nycticebus coucang</i>	12	10	03	25	10
<i>Trachypithecus johnii</i>	03	09	04	25	9
<i>Macaca nemestrina</i>	08	08	00	18	9
<i>Macaca fascicularis umbrosa</i>	10	07	00	17	1
<i>Trachypithecus geei</i>	09	08	00	17	10
<i>Loris tardigradus</i>	01	05	03	09	3
<i>Hylobates hoolock</i>	05	04	09	09	9
<i>Trachypithecus phayrei</i>	02	02	00	04	1



Table 5. Taxonomic and Nomenclature Changes in Indian Primates

Name: CAZ Database	Changes in Taxonomy and Nomenclature according to Groves, Colin (2001) <i>Primates Taxonomy</i> , Smithsonian Institution, 348 pp.
<i>Macaca fascicularis umbrosa</i>	No changes
<i>Trachypithecus geei</i>	No changes
<i>Hylobates hoolock</i>	Name change: <i>Hylobates</i> (? <i>Bunopithecus</i>) <i>hoolock hoolock</i> (Harlan, 1834)
<i>Macaca silenus</i>	No change
<i>Trachypithecus phayrei</i>	Name change: <i>Trachypithecus phayrei phayrei</i>
<i>Trachypithecus johnii</i>	No change
<i>Loris tardigradus</i>	Taxonomic changes—subspecies added: <i>Loris lydekkerianus lydekkerianus</i> (Cabrere, 1908) Mysore Slender Loris <i>Loris lydekkerianus malabaricus</i> (Wroughton, 1917), Malabar Slender Loris
<i>Macaca arctoides</i>	Name change: <i>Macaca speciosa</i> <i>Macaca arctoides</i> now refers to Burmese subspecies
<i>Macaca assamensis</i>	Taxonomic changes—subspecies added: <i>Macaca arctoides</i> (I. Geoffroy, 1831) Stump-tailed/Bear Macaque India: Northeastern—South of Brahmaputra; Burma: Northern <i>Macaca assamensis assamensis</i> (McClelland, 1839) Assam Macaque p. 234. India: North along Dihang (= middle Brahmaputra) <i>Macaca assamensis pelops</i> (Hodgson, 1840) Assam Macaque p. 234. India: Sikkim, northernmost West Bengal, Sundarbans; Nepal: Central; Bhutan: Central
<i>Nycticebus coucang</i>	Name change: <i>Nycticebus bengalensis</i> (Lacépède, 1800) Bengal Slow Loris
<i>Trachypithecus pileatus</i>	Taxonomic changes—subspecies added: <i>Trachypithecus pileatus pileatus</i> (Blyth, 1843) Capped Langur <i>Trachypithecus pileatus brahma</i> (Wroughton, 1916) Capped Langur <i>Trachypithecus pileatus durga</i> (Wroughton, 1916) Capped Langur <i>Trachypithecus pileatus tenebricus</i> (Hinton, 1923) Capped Langur
<i>Macaca mulatta</i>	No change
<i>Macaca radiata</i>	Taxonomic changes—subspecies: <i>Macaca radiata radiata</i> (E. Geoffroy, 1812) Bonnet Macaque <i>Macaca radiata diluta</i> (Pocock, 1931) Bonnet Macaque
<i>Semnopithecus entellus</i>	Taxonomic changes: <i>Semnopithecus entellus</i> (Common Hanuman langur) is now seven species instead of one: <i>Semnopithecus entellus entellus</i> (Dufresne, 1797) Northern Plains Gray Langur <i>Semnopithecus entellus</i> Subspecies <i>Semnopithecus ajax</i> (Pocock, 1928) Kashmir Gray Langur <i>Semnopithecus dussumieri</i> (I. Geoffroy, 1843) Southern Plains Gray Langur <i>Semnopithecus hector</i> (Pocock, 1928) Tarai Gray Langur <i>Semnopithecus hypoleucos</i> (Blyth, 1841) Black-footed Gray Langur <i>Semnopithecus priam</i> (Blyth, 1844) Tufted Gray Langur <i>Semnopithecus schistaceus</i> (Hodgson, 1840) Nepal Gray Langur
<i>Macaca nemestrina</i>	Name change: now named <i>Macaca leonina</i> (Blyth, 1863)



Status of Captive Primates in Indian Zoos

P. R. Sinha & Bipul Chakraborty



Position of Primate Species in Zoos as on 31/03/1999

A) Indian Species				
Hoolock Gibbon (<i>Bunopithecus hoolock</i>)	Male	Female	Unsex	Total
1. Assam State Zoo Cum Botanical Garden, Guwahati, Assam	1	0	0	1
2. Mini Zoo, Roing, Arunachal Pradesh	0	1	0	1
3. National Zoological Park, Delhi	0	1	0	1
4. Manipur Zoological Garden, Imphal, Manipur	1	1	0	2
5. Aizawl Zoo, Aizawl, Mizoram	0	1	0	1
6. Prince of Wales Zoological Gardens, Lucknow, Uttar Pradesh	1	1	0	2
Subtotal	3	5	0	8
Golden Langur (<i>Trachypithecus geei</i>)	Male	Female	Unsex	Total
1. Nehru Zoological Park, Hyderabad, Andhra Pradesh	1	2	0	3
2. Assam State Zoo Cum Botanical Garden, Guwahati, Assam	1	3	0	4
3. Mini Zoo, Roing, Arunachal Pradesh	0	1	0	1
4. Jawaharlal Nehru Biological Park Bokaro, Bihar	1	0	0	1
5. National Park, Bannerghatta Zoological Garden, Bangalore, Karnataka	0	1	0	1
6. Zoological Park, Kohima, Nagaland	1	0	0	1
7. Kanpur Zoological Park, Kanpur	1	1	0	2
Subtotal	5	8	0	13
Phayre's Langur (<i>Trachypithecus phayrei</i>)	Male	Female	Unsex	Total
1. Sepahijala Zoological Park, Sepahijala, Tripura	1	2	0	3
Subtotal	1	2	0	3

Capped Langur (<i>Trachypithecus pileatus</i>)	Male	Female	Unsex	Total
1. Nehru Zoological Park, Hyderabad, Andhra Pradesh	1	2	0	3
2. Assam State Zoo Cum Botanical Garden, Guwahati, Assam	1	0	0	1
3. Sanjay Gandhi Biological Park, Patna, Bihar	1	0	0	1
4. Jawaharlal Nehru Biological Park, Bokaro, Bihar	0	2	0	2
5. Kamla Nehru Zoological Garden, Ahmedabad, Gujarat	0	2	0	2
6. Sayaji Baug Zoo, Vadodara, Gujarat	1	0	0	1
7. National Park, Bannerghatta Zoological Garden, Bangalore, Karnataka	0	1	0	1
8. Manipur Zoological Garden, Imphal, Manipur	1	0	0	1
9. Zoological Park, Kohima	1	1	0	2
10. Mahendra Chaudhury Zoological Park, Chattbir, Chandigarh, Punjab	2	1	0	3
11. Jaipur Zoo, Jaipur, Rajasthan	0	1	0	1
12. Arignar Anna Zoological Park, Vandalur, Tamil Nadu	2	0	0	2
13. Kanpur Zoological Park, Kanpur, Uttar Pradesh	1	1	0	2
Subtotal	11	11	0	22
Nilgiri Langur (<i>Trachypithecus johnii</i>)	Male	Female	Unsex	Total
1. Indira Gandhi Zoological Park, Visakhapatnam, Andhra Pradesh	1	1	0	2
2. Nehru Zoological Park, Hyderabad, Andhra Pradesh	0	0	0	0
3. Sri Chamarajendra Zoological Gardens, Mysore, Karnataka	1	2	0	3
4. Thiruvananthapuram Zoo, Thiruvananthapuram, Kerala	0	1	0	1
5. Mini Zoo, Kodanadu, Karnataka	0	0	1	1
6. Veermata Jijabai Bhosale Udyan & Zoo, Mumbai, Maharashtra	2	2	0	4
7. Nandankanan Biological Park, Bhubaneswar, Orissa	1	0	0	1
8. Arignar Anna Zoological Park, Vandalur, Tamil Nadu	4	4	2	10
9. V.O.C. Park Mini Zoo, Coimbatore, Tamil Nadu	2	1	0	3
10. Kanur Zoological Park, Kanpur, Uttar Pradesh	0	1	0	1
11. Parassinikkadavu Snake Park, Kannur, Kerala	2	0	0	2
Subtotal	13	12	3	28
Stump-Tailed Macaque (<i>Macaca arctoides</i>)	Male	Female	Unsex	Total
1. Sri Venkateswara Zoological Park, Tirupati, Andhra Pradesh	3	1	0	4
2. Assam State Zoo Cum Botanical Garden, Guwahati, Assam	4	2	0	6
3. Zoological Park, Itanagar, Arunachal Pradesh	1	0	0	1
4. Miao Mini Zoo, Miao, Arunachal Pradesh	0	1	0	1
5. Sanjay Gandhi Biological Park, Patna, Bihar	5	4	1	10





6. Jawaharlal Nehru Biological Park, Bokaro, Bihar	1	1	0	2
7. Sri Chamarajendra Zoological Gardens, Mysore, Karnataka	0	1	0	1
8. Sanjay Gandhi National Park, Borivali (East), Maharashtra	1	1	0	2
9. Aurangabad Municipal Zoo, Aurangabad, Gujarat	1	0	0	1
10. Manipur Zoological Garden, Imphal, Manipur	5	6	0	11
11. Prince of Wales Zoological Gardens, Lucknow, Uttar Pradesh	0	2	4	6
12. Kanpur Zoological Park, Kanpur, Uttar Pradesh	1	0	0	1
Subtotal	22	19	5	46
Pig-Tailed Macaque (<i>Macaca nemestrina</i>)	Male	Female	Unsex	Total
1. Assam State Zoo Cum Botanical Garden, Guwahati, Assam	5	2	0	7
2. Sanjay Gandhi Biological Park, Patna, Bihar	1	0	0	1
3. Kamla Nehru Zoological Garden, Ahmedabad, Gujarat	0	1	0	1
4. Mahendra Chaudhary Zoological Park, Chhatbir, Punjab	1	1	0	2
5. V.O.C. Park Mini Zoo, Coimbatore, Tamil Nadu	0	1	0	1
6. Sepahijala Zoological Park, Sepahijala, Tripura	1	1	0	2
7. Prince of Wales Zoological Gardens, Lucknow, Uttar Pradesh	0	1	0	1
8. Kanpur Zoological Park, Kanpur, Uttar Pradesh	1	0	0	1
9. Zoological Garden, Alipore, West Bengal	1	0	0	1
Subtotal	10	7	0	17
Lion-tailed Macaque (<i>Macaca silenus</i>)	Male	Female	Unsex	Total
1. Nehru Zoological Park, Hyderabad, Andhra Pradesh	1	0	0	1
2. Assam State Zoo Cum Botanical Garden, Guwahati, Assam	0	1	0	1
3. Sanjay Gandhi Biological Park, Patna, Bihar	3	2	0	5
4. National Zoological Park, Delhi	2	2	0	4
5. Bellary Children's Park Cum Zoo, Bellary, Karnataka	0	1	0	1
6. Children's Mini Zoo, Dharwad, Karnataka	1	0	0	1
7. National Park, Bannerghatta Zoological Garden, Bangalore, Karnataka	1	2	0	3
8. Sri Chamarajendra Zoological Gardens, Mysore, Karnataka	1	3	0	4
9. Thiruvananthapuram Zoo, Thiruvananthapuram, Kerala	4	4	0	8
10. State Museum & Zoo, Thrissur, Kerala	3	0	0	3
11. Mini Zoo, Kodanadu, Karnataka	0	0	4	4
12. Maitri Baagh Zoo, Bhilai	2	1	0	3
13. Peshwe Park Zoological Gardens, Pune, Maharashtra	1	0	0	1

14. Nandankanan Biological Park, Bhubaneswar, Orissa	2	2	0	4
15. Mahendra Chaudhury Zoological Park, Chhatbir, Punjab	2	1	0	3
16. Jaipur Zoo, Jaipur, Rajasthan	1	2	0	3
17. Arignar Anna Zoological Park, Vandalur, Tamil Nadu	3	1	4	8
18. Sepahijala Zoological Park, Sepahijala, Tripura	0	1	0	1
19. Kanpur Zoological Park, Kanpur, Uttar Pradesh	1	2	0	3
20. Zoological Garden, Alipore, West Bengal	1	1	0	2
21. Parassinikadavu Snake Park, Kannur, Kerala	0	2	0	2
Subtotal	29	28	8	65
Crab-eating/Long-Tailed Macaque (<i>Macaca fascicularis</i>)	Male	Female	Unsex	Total
1. Children's Corner, Guindy, Tamil Nadu	1	1	0	2
2. Mini Zoo, Haddo, Port Blair, Andaman & Nicobar Islands	10	7	0	17
Subtotal	11	8	0	19
Rhesus Macaque (<i>Macaca mulatta</i>)	Male	Female	Unsex	Total
1. Indira Gandhi Zoological Park, Visakhapatnam, Andhra Pradesh	6	2	1	9
2. Sri Venkateswara Zoological Park, Tirupati, Andhra Pradesh	2	1	1	4
3. Nehru Zoological Park, Hyderabad, Andhra Pradesh	0	2	0	2
4. Pillalamarri Deer Park, Mahabub Nagar	0	0	4	4
5. Zoological Park, Itanagar, Arunachal Pradesh	4	4	4	12
6. Satsang Zoo for Children Education Satsang	1	0	0	1
7. Sanjay Gandhi Biological Park, Patna, Bihar	25	23	0	48
8. Jawaharlal Nehru Biological Park, Bokaro, Bihar	8	3	0	11
9. Bhagwan Birsa Biological Park, Ranchi, Bihar	6	5	0	11
10. Tata Steel Zoological Park, Jamshedpur, Bihar	6	5	0	11
11. National Zoological, Park, Delhi	18	16	0	34
12. Khanvel Deer Park, Silvassa	0	0	4	4
13. Mini Zoo Silvassa Khanvel	0	0	4	4
14. Sundervan Nature Discovery Centre, Jodhpur Tekra	0	3	0	3
15. Sakkarbaug Zoo, Junagarh, Gujarat	3	1	0	4
16. Kamla Nehru Zoological Garden, Ahmedabad, Gujarat	14	11	4	29
17. Fertilizer Nagar Deer Park, Baroda	0	0	3	3
18. Nature Park, Surat, Gujarat	2	2	0	4
19. Sayaji Baug Zoo, Vadodara, Gujarat	3	5	0	8





20. Nature Education Centre, Jamnagar, Gujarat	0	0	4	4
21. Mini Zoo, Pipli, Pipli	1	2	0	3
22. Bellary Children's Park Cum Zoo, Bellary, Karnataka	1	2	0	3
23. Children's Park Mini Zoo, Shimoga, Karnataka	1	0	0	1
24. Deer Children & Snake Park, Kadri Hill, Mangalore, Karnataka	3	1	0	4
25. National Park, Bannerghatta Zoological Garden, Bangalore, Karnataka	1	4	0	5
26. Sri Chamarajendra Zoological Gardens, Mysore, Karnataka	4	2	0	6
27. Kudremukh Mini Zoo, Chickmagalur, Karnataka	0	0	6	6
28. Thiruvananthapuram Zoo, Thiruvananthapuram, Kerala	1	0	0	1
29. State Museum & Zoo, Thrissur, Kerala	0	1	0	1
30. Nandan Van, Raipur, Jharkand	0	0	2	2
31. Maitri Baagh Zoo, Bhilai, Madhya Pradesh	2	3	0	5
32. Gandhi Zoological Park, Gwalior, Madhya Pradesh	6	8	8	22
33. Kamla Nehru Prani Sangrahalay Zoo, Indore, Madhya Pradesh	7	5	3	15
34. Mahatma Gandhi Rastriya Udyan Zoo, Solapur, Maharashtra	0	0	24	24
35. Maharajabag Zoo, Nagpur, Maharashtra	2	1	0	3
36. Vivekanand Vidya Mandir Zoo, Buldana	3	3	0	6
37. Amte's Animal Park & Orphanage Cum Rescue	4	3	0	7
38. Veermata Jijabai Bhosale Udyan & Zoo, Mumbai, Maharashtra	3	4	0	7
39. Sanjay Gandhi National Park, Borivali (East), Maharashtra	1	2	0	3
40. Hutatma Bag Prani Sangrahalaya, Solapur, Maharashtra	0	0	1	1
41. Aurangabad Municipal Zoo, Aurangabad, Maharashtra	1	3	0	4
42. Somnath Prakala Zoo, Chandrapur, Maharashtra	2	3	0	5
43. Shri Ganjanan Vatika, Buldana	1	1	0	2
44. Pal Wild Animal Orphanage, Jal Gaon	1	0	0	1
45. Lady Hydari Park, Animal Land, Shillong, Meghalaya	11	7	0	18
46. Manipur Zoological Garden, Imphal, Manipur	12	11	3	26
47. Aizawl Zoo, Aizal, Mizoram	9	8	0	17
48. Indira Gandhi Park Zoo & Deer Park, Rourkela, Orissa	1	2	0	3
49. Motijharan Deer Park, Sambalpur, Orissa	0	0	1	1
50. Nandankanan Biological Park, Bhubaneswar, Orissa	2	0	0	2
51. Mini Zoo, Ram Bagh, Amritsar, Punjab	0	0	7	7
52. Deer Park, Bir Talab, Bhatinda, Punjab	0	0	8	8
53. Mahendra Chaudhury Zoological Park, Chattbir, Punjab	1	1	0	2
54. Zoological Garden Public Park, Bikaner, Rajasthan	7	4	0	11

55. Udaipur Zoo, Udaipur, Rajasthan	3	3	0	6
56. Jodhpur Zoo, Jodhpur, Rajasthan	4	5	0	9
57. Kota Zoo, Kota	1	1	1	3
58. Jaipur Zoo, Jaipur, Rajasthan	1	1	0	2
59. Baguwa Pheasant Farm, Gangtok, Sikkim	1	1	0	2
60. Arignar Anna Zoological Park, Vandalur, Tamil Nadu	13	9	1	23
61. Montfort School Mini Zoo, Yercaud, Salem, Tamil Nadu	0	0	2	2
62. Children's Corner, Guindy, Tamil Nadu	1	1	0	2
63. V.O.C. Park Mini Zoo, Coimbatore, Tamil Nadu	2	3	0	5
64. Kurumbapatti Zoological Park, Salem, Tamil Nadu	0	2	0	2
65. Amirdhi Zoo, Vellore, Tamil Nadu	0	0	2	2
66. Deer Park, Narain Tewari Dewal Almora, Uttar Pradesh	1	0	0	1
67. Prince Of Wales Zoological Gardens Lucknow, Uttar Pradesh	5	2	2	9
68. Kanpur Zoological Park, Kanpur, Uttar Pradesh	2	2	0	4
69. Calcutta Snake Park, Zoological Garden, Badu, West Bengal	1	1	0	2
70. Deer Park Dow Hill, Kurseong, West Bengal	2	0	0	2
71. Deer Park (Mini Zoo), Jhargram West Bengal	0	0	3	3
72. Zoological Garden, Alipore West Bengal	5	1	4	10
73. Mini Zoo, Haddo, Port Blair, Andaman & Nicobar Islands	1	1	0	2
74. Regional Science	2	2	0	4
Subtotal	231	199	107	537
Rhesus Macaque (albino) (<i>Macaca mulatta</i>)	Male	Female	Unsex	Total
1. Sri Chamarajendra Zoological Gardens Mysore, Karnataka	1	1	0	2
Subtotal	1	1	0	2
Assamese Macaque (<i>Macaca assamensis</i>)	Male	Female	Unsex	Total
1. Assam State Zoo Cum Botanical Garden, Guwahati, Assam	1	0	0	1
2. Zoological Park, Itanagar, Arunachal Pradesh	1	0	0	1
3. Mini Zoo, Roing, Arunachal Pradesh	2	2	0	4
4. Miao Mini Zoo, Miao, Arunachal Pradesh	2	1	0	3
5. Sanjay Gandhi Biological Park, Patna, Bihar	2	1	5	8
6. National Zoological Park, Delhi	2	4	0	6
7. National Park, Bannerghatta Zoological Garden, Bangalore, Karnataka	1	0	0	1
8. Maitri Baagh Zoo, Bhilai, Madhya Pradesh	1	0	0	1



9. Mahatma Gandhi Rastriya Udyan Zoo, Solapur, Maharashtra	0	0	1	1
10. Hutatma Bag Prani Sangrahalaya Solapur, Maharashtra	0	0	3	3
11. Manipur Zoological Garden, Imphal, Manipur	2	2	0	4
12. Nandankanan Biological Park, Bhubaneswar, Orissa	1	1	0	2
13. Mahendra Chaudhury Zoological Park,Chattbir, Punjab	16	19	0	35
14. Jaipur Zoo, Jaipur, Rajasthan	3	0	0	3
15. Rustomji Deer Park, Gangtok, Sikkim	1	0	0	1
16. Sepahijala Zoological Park, Sepahijala, Tripura	5	3	0	8
17. Zoological Garden, Alipore, West Bengal	4	2	3	9
Subtotal	44	35	12	91
Bonnet Macaque (<i>Macaca radiata</i>)	Male	Female	Unsex	Total
1. Indira Gandhi Zoological Park, Visakhapatnam, Andhra Pradesh	6	6	0	12
2. Sri Venkateswara Zoological Park, Tirupati, Andhra Pradesh	4	2	2	8
3. Nehru Zoological Park, Hyderabad, Andhra Pradesh	1	1	0	2
4. Assam State Zoo Cum Botanical Garden, Guwahati, Assam	1	0	0	1
5. Sanjay Gandhi Biological Park, Patna, Bihar	1	0	0	1
6. Jawaharlal Nehru Biological Park, Bokaro, Bihar	4	3	0	7
7. Tata Steel Zoological Park, Jamshedpur, Bihar	2	1	0	3
8. National Zoological Park, Delhi	2	4	1	7
9. Sakkarbaug Zoo, Junagarh Gujarat	4	3	0	7
10. Kamla Nehru Zoological Garden, Ahmedabad, Gujarat	6	2	2	10
11. Nature Park, Surat, Gujarat	2	4	0	6
12. Sayaji Baug Zoo, Vadodara Gujarat	1	2	0	3
13. Mini Zoo, Jind	4	3	2	9
14. Mini Zoo, Bhiwani	2	2	1	5
15. Mini Zoo Pipli	3	3	0	6
16. Rohtak Zoo, Rohtak	3	5	0	8
17. Mini Zoo, Abubshahar, Dist. Sirsa	1	1	0	2
18. Bellary Children's Park Cum Zoo, Bellary, Karnataka	1	3	0	4
19. Children's Mini Zoo, Dharwad, Karnataka	8	4	0	12
20. Mini Zoo Cum Children Park, Gulbarga, Karnataka	0	0	2	2
21. Sri Chamarajendra Zoological Gardens, Mysore, Karnataka	1	0	0	1
22. Thiruvananthapuram Zoo, Thiruvananthapuram, Kerala	5	4	0	9



23. State Museum & Zoo, Thrissur, Kerala	19	18	0	37
24. Mini Zoo, Kodanadu, Karnataka	0	0	21	21
25. Van Vihar National Park, Bhopal, Madhya Pradesh	0	0	162	162
26. Maitri Baagh Zoo, Bhilai, Madhya Pradesh	2	0	0	2
27. Gandhi Zoological Park, Gwalior, Madhya Pradesh	4	3	0	7
28. Kamla Nehru Prani Sangrahalay Zoo, Indore, Madhya Pradesh	1	1	0	2
29. Mahatma Gandhi Rastriya Udyan Zoo, Solapur, Maharashtra	0	0	15	15
30. Veermata Juabai Bhosale Udyan & Zoo, Mumbai, Maharashtra	4	3	0	7
31. Peshwe Park Zoological Gardens, Pune, Maharashtra	3	3	0	6
32. Aurangabad Municipal, Zoo, Aurangabad, Maharashtra	0	4	0	4
33. Shri Ganjanan Vatika Buldana	3	0	0	3
34. Manipur Zoological Garden, Imphal, Manipur	2	2	0	4
35. Nandankanan Biological Park, Bhubaneswar, Orissa	3	2	0	5
36. Mahendra Chaudhury Zoological Park, Chattbir, Punjab	5	2	0	7
37. Zoological Garden, Bikaner, Rajasthan	2	0	0	2
38. Jodhpur Zoo, Jodhpur, Rajasthan	1	0	0	1
39. Jaipur Zoo, Jaipur, Rajasthan	3	2	0	5
40. Arignar Anna Zoological Park, Vandalur, Tamil Nadu	11	6	0	17
41. Children's Corner, Guindy, Tamil Nadu	10	17	0	27
42. V.O.C. Park Mini Zoo, Coimbatore, Tamil Nadu	3	5	1	9
43. Malsi Deer Park, Dehradun, Uttaranchal	2	2	0	4
44. Prince of Wales Zoological Gardens Lucknow, Uttar Pradesh	8	2	4	14
45. Kanpur Zoological Park, Kanpur, Uttar Pradesh	6	2	0	8
46. Zoological Garden, Alipore, West Bengal	0	0	24	24
47. Parassinikadavu Snake Park, Kannur, Kerala	4	3	0	7
Subtotal	158	130	237	525
Slow Loris (<i>Nycticebus coucang</i>)	Male	Female	Unsex	Total
1. Assam State Zoo Cum Botanical Garden, Guwahati, Assam	1	1	0	2
2. Miao Mini Zoo, Miao, Arunachal Pradesh	2	0	0	2
3. Sanjay Gandhi Biological Park, Patna, Bihar	5	1	0	6
4. Bhagwan Birsa Biological Park, Ranchi, Bihar	1	0	0	1
5. Kamla Nehru Zoological Garden, Ahmedabad, Gujarat	0	1	0	1
6. Lady Hydari Park, Animal Land, Shillong, Meghalaya	2	2	0	4



7. Manipur Zoological Garden, Imphal, Manipur	2	1	0	3
8. Jaipur Zoo, Jaipur, Rajasthan	1	0	0	1
9. Zoological Garden, Alipore, West Bengal	0	0	1	1
Subtotal	14	6	1	21
Slender Loris (<i>Loris tardigradus</i>)	Male	Female	Unsex	Total
1. Nehru Zoological Park, Hyderabad, Andhra Pradesh	1	0	0	1
2. Sri Chamarajendra Zoological Gardens, Mysore, Karnataka	0	0	1	1
3. Arignar Anna Zoological Park, Vandalur, Tamil Nadu	0	0	1	1
4. Children's Corner, Guindy, Tamil Nadu	1	0	0	1
Subtotal	2	0	2	4
Hanuman Langur (<i>Semnopithecus entellus</i>)	Male	Female	Unsex	Total
1. Indira Gandhi Zoological Park, Visakhapatnam, Andhra Pradesh	1	2	0	3
2. Assam State Zoo Cum Botanical Garden, Guwahati, Assam	2	1	0	3
3. Sanjay Gandhi Biological Park, Patna, Bihar	15	4	0	19
4. Jawaharlal Nehru Biological Park, Bokaro, Bihar	3	2	0	15
5. Bhagwan Birsa Biological Park, Ranchi, Bihar	1	1	0	2
6. Tata Steel Zoological Park, Jamshedpur, Bihar	3	3	1	7
7. National Zoological Park, Delhi	7	8	0	15
8. Sakkarbaug Zoo, Junagarh, Gujarat	1	0	0	1
9. Kamla Nehru Zoological Garden, Ahmedabad, Gujarat	3	1	0	4
10. Sayaji Baug Zoo, Vadodara, Gujarat	1	3	0	4
11. Mini Zoo, Bhiwani	1	1	0	2
12. Mini Zoo, Pipli, Pipli	2	1	1	4
13. Rohtak Zoo, Rohtak		2	1	0 3
14. Mini zoo, Abubshahar, Dist, Sirsa	0	1	0	1
15. Sri Chamarajendra Zoological Gardens, Mysore, Karnataka	0	2	0	2
16. Thiruvananthapuram Zoo, Thiruvananthapuram, Kerala	3	2	0	5
17. Maitri Baagh Zoo, Bhilai, Madhya Pradesh	0	3	0	3
18. Gandhi Zoological Park, Gwalior, Madhya Pradesh	1	0	0	1
19. Kamla Nehru Prani Sangrahalay Zoo, Indore, Madhya Pradesh	1	2		1 4
20. Veermata Jijabai Bhosale Udyan & Zoo, Mumbai, Maharashtra	5	2	0	7
21. Rani Bag Zoo, Buldana	2	2	0	4
22. Mahatma Bag Prani Sangrahalaya, Solapur, Maharashtra	0	0	2	2

23. Kanan Pandari, Bilaspur, Madhya Pradesh	3	1	0	4
24. Zoological Park, Kohima	9	3	0	12
25. Nandankhan Biological Park, Bhubaneswar, Orissa	1	2	0	3
26. Mini Zoo, Bansar Bah, Sangrur	0	0	2	2
27. Deer Park, Bir Talab, Bhatinda	0	0	3	3
28. Mahendra Chaudhury Zoological Park, Chhattbir, Punjab	1	1	0	2
29. Arignar Anna Zoological Park, Vandalur, Tamil Nadu	2	1	1	4
30. Children's Corner Guindy, Tamil Nadu	1	1	0	2
31. Kurumbapatti Zoological Park, Salem, Tamil Nadu	3	3	0	6
32. Malsi Deer Park, Dehradun, Uttaranchal	1	2	0	3
33. Aranaya Bhawan, Buland Shahar	0	0	2	2
34. Prince of Wales Zoological Gardens, Lucknow, Uttar Pradesh	1	2	1	4
35. Kanpur Zoological Park, Kanpur, Uttar Pradesh	1	1	0	2
36. Deer Park (Mini Zoo), Jhargram	0	0	2	2
37. Padmaja Naidu Himalayan Zoological Park, West Bengal	2	0	0	2
38. Zoological Garden, Alipore, West Bengal	2	0	1	3
Subtotal	81	59	17	157
B) Non-Indian Species				
Hamadryas Baboon (<i>Papio hamadryas</i>)	Male	Female	Unsex	Total
1. Indira Gandhi Zoological Park, Visakhapatnam, Andhra Pradesh	2	3	0	5
2. Nehru Zoological Park, Hyderabad, Andhra Pradesh	2	1	0	3
3. National Zoological Park, Delhi	4	3	0	7
4. Mini Zoo, Pipli, Pipli	1	0	0	1
5. Sri Chamarajendra Zoological Gardens, Mysore, Karnataka	2	0	0	2
6. Jaipur Zoo, Jaipur, Rajasthan	1	0	0	1
7. Prince of Wales Zoological Gardens, Lucknow, Uttar Pradesh	1	0	0	1
8. Kanpur Zoological Park, Kanpur, Uttar Pradesh	2	1	0	3
9. Zoological Garden, Alipore, West Bengal	1	0	0	1
Subtotal	16	8	0	24
Savanna Baboon (<i>Papio cynocephalus</i>)	Male	Female	Unsex	Total
1. Arignar Anna Zoological Park, Vandalur, Tamil Nadu	3	0	0	3
Subtotal	3	0	0	3





Olive Baboon (<i>Papio cynocephalus</i>)		Male	Female	Unsex	Total
1.	Indira Gandhi Zoological Park, Visakhapatnam, Andhra Pradesh	2	2	0	4
2.	Nehru Zoological Park, Hyderabad, Andhra Pradesh	2	1	0	3
3.	State Museum & Zoo, Thrissur, Kerala	1	0	0	1
Subtotal		5	3	0	8
Yellow Baboon (<i>Papio cynocephalus</i>)		Male	Female	Unsex	Total
1.	Nehru Zoological Park, Hyderabad, Andhra Pradesh	1	2	0	3
Subtotal		1	2	0	3
Chacma Baboon (<i>Papio cynocephalus</i>)		Male	Female	Unsex	Total
1.	Nehru Zoological Park, Hyderabad, Andhra Pradesh	0	1	0	1
2.	Sri Chamarajendra Zoological Gardens, Mysore, Karnataka	1	2	0	3
Subtotal		1	3	0	4
Mandrill (<i>Papio sphinx</i>)		Male	Female	Unsex	Total
1.	Sri Chamarajendra Zoological Gardens, Mysore, Karnataka	0	2	0	2
Subtotal		0	2	0	2
Drill Baboon (<i>Papio leucophaeus</i>)		Male	Female	Unsex	Total
1.	Nandankanan Biological Park, Bhubaneswar	0	2	0	2
Subtotal		0	2	0	2
African Red Patas Monkey (<i>Erythrocebus patas</i>)		Male	Female	Unsex	Total
1.	Nehru Zoological Park, Hyderabad, Andhra Pradesh	1	1	0	2
2.	Nandankanan Biological Park, Bhubaneswar, Orissa	0	1	0	1
Subtotal		1	2	0	3
Squirrel Monkey (<i>Saimiri sciureus</i>)		Male	Female	Unsex	Total
1.	Nandankanan Biological Park, Bhubaneswar, Orissa	2	2	0	4
2.	Kanpur Zoological Park, Kanpur, Uttar Pradesh	2	3	0	5
Subtotal		2	4	0	6
White-Fronted Marmoset (<i>Callithrix geoffroyi</i>)		Male	Female	Unsex	Total
1.	Sri Chamarajendra Zoological Gardens, Mysore, Karnataka	1	1	0	2
Subtotal		1	1	0	2

Chimpanzee (<i>Pan troglodytes</i>)	Male	Female	Unsex	Total
1. Nehru Zoological Park, Hyderabad, Andhra Pradesh	1	3	0	4
2. National Zoological Park, Delhi	1	1	0	2
3. Sayaji Baug Zoo, Vadodara, Gujarat	1	0	0	1
4. Sri Chamarajendra Zoological Gardens, Mysore, Karnataka	3	3	0	6
5. Nandankanan Biological Park, Bhubaneswar, Orissa	1	1	0	2
6. Mahendra Chaudhury Zoological Park, Chattbir, Punjab	0	1	0	1
7. Jaipur Zoo, Jaipur, Rajasthan	0	1	0	1
8. Arignar Anna Zoological Park, Vandalur, Tamil Nadu	2	1	0	3
9. Prince of Wales Zoological Gardens, Lucknow, Uttar Pradesh	1	0	0	1
10. Kanpur Zoological Park, Kanpur, Uttar Pradesh	1	1	0	2
11. Zoological Garden, Alipore, West Bengal	2	2	0	4
Subtotal	13	14	0	27
Orangutan (<i>Pongo pygmaeus</i>)	Male	Female	Unsex	Total
1. Nehru Zoological Park, Hyderabad, Andhra Pradesh	3	1	0	4
2. Peshwe Park Zoological Gardens, Pune, Maharashtra	0	1	0	1
3. Kanpur Zoological Park, Kanpur, Uttar Pradesh	1	1	0	2
Subtotal	4	3	0	7
Grey-Cheeked Mangaby (<i>Cercocebus albingena</i>)	Male	Female	Unsex	Total
1. Arignar Anna Zoological Park, Vandalur, Tamil Nadu	1	1	0	2
Subtotal	1	1	0	2
Sooty Mangaby (<i>Cercocebus atys</i>)	Male	Female	Unsex	Total
1. Thiruvananthapuram Zoo, Thiruvananthapuram, Kerala	0	1	0	1
Subtotal	0	1	0	1
African Wolf Monkey (<i>Cercopithecus Wolfi</i>)	Male	Female	Unsex	Total
1. Nehru Zoological Park, Hyderabad, Andhra Pradesh	0	2	0	2
Subtotal	0	2	0	2
African Green Monkey (<i>Cercopithecus aethiops</i>)	Male	Female	Unsex	Total
1. Nehru Zoological Park, Hyderabad, Andhra Pradesh	2	2	0	4
Subtotal	2	2	0	4



Capuchin Monkey (<i>Cebus capucinus</i>)	Male	Female	Unsex	Total
1. Tata Steel Zoological Park, Jamshedpur, Bihar	2	0	0	2
2. Thiruvananthapuram Zoo, Thiruvananthapuram, Kerala	3	0	0	3
3. Jaipur Zoo, Jaipur, Rajasthan	1	0	0	1
4. Prince of Wales Zoological Gardens, Lucknow, Uttar Pradesh	4	1	0	5
5. Kanpur Zoological Park, Kanpur, Uttar Pradesh	6	1	0	7
Subtotal	16	2	0	18
Brown Capuchin (<i>Cebus apella</i>)	Male	Female	Unsex	Total
1. Arignar Anna Zoological Park, Vandalur, Tamil Nadu	0	2	0	2
Subtotal	0	2	0	2
Spider Monkey (<i>Ateles paniseus</i>)	Male	Female	Unsex	Total
1. Jaipur Zoo, Jaipur, Rajasthan	0	1	0	1
Subtotal	0	1	0	1
Grand Total	706	590	392	1,688



Conservation Assessment and Management Plan Workshop for South Asian Primates—Red Listing at the Regional Level

Sally Walker & Sanjay Molur

Introduction

The IUCN Red Data Books and, more recently, the IUCN Red List of Threatened Species, have relied on what has been, to a great extent, indirect information. IUCN Specialist Group Chairpersons or their designates have to collect information on a large number of species from specialists all over the world. Most often the information is 2nd or 3rd hand by the time it reaches IUCN and may also be incomplete. The Conservation Assessment and Management Plan (CAMP) Workshop provides a means for currently working field biologists from the range states of the taxon group to actively participate in Red Listing the species they study. Such a workshop was held from 5 to 9 March in Coimbatore at the State Forest Service College for Primates of South Asia. The workshop also provided an opportunity for field biologists from the region and members of the Primate Specialist Group responsible for revising primate taxonomy to interact, in order to review, refine and confirm aspects of the new taxonomy.

Background

Primates are man's nearest living relatives in the animal kingdom. Due to their similarity to man both in behaviour and appearance they

are objects of fascination, as well as delight and even disgust. Primate numbers vary from a very few dozen in some remote forest areas to hundreds and thousands which have found a comfortable environment for themselves, although not to the liking of their human relatives, even in cities. Primates play an important ecological role serving as seed dispersers, prey for carnivorous animals, etc. Habitat loss, hunting and development has led to the decline in populations of many primate species throughout South Asia.

In 1997, a Conservation Assessment and Management Plan CAMP workshop for Indian mammals was held at the Indian Institute of Science, Bangalore under the auspices of the Biodiversity Conservation Prioritization Project (BCPP). In this workshop, which was conducted by the Conservation Breeding Specialist Group (CBSG), India among others, 15 primates were considered but not all could be assessed due to insufficient participation of primatologists from different parts of the country. The IUCN status for Indian endemic species, as derived by the workshop using the then new 1994 IUCN Red List criteria, was used by the Primate Specialist Group in their recommendations for the 2000 Red List. The 2000 IUCN Red List also included endemic



Indian primate subspecies which had not been considered in the 1997 BCPP CAMP. As a result of the taxonomic revisions, it can be said that South Asia is rich in varieties of primates. Now, there are 45 species and subspecies of primates in South Asia, a number of them endemic to the region.

The taxonomic revisions which have taken place since 1997 and are still under review affect the number, nomenclature and status of several primate species and subspecies. This and the insufficiency of the 1997 output led to an initiative by CBSG, South Asia and the Primate Specialist Group to organize a CAMP Review with primates of the entire South Asian region also included. South Asia is defined as the 7 countries which make up the South Asian Association for Regional Cooperation (SAARC), e.g. Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan, and Sri Lanka. The workshop was held from 5 to 9 March 2002, hosted by the State Forest Service College in R.S. Puram, Coimbatore.

CAMP Workshop

Despite the fact that primate studies have been going on for many years, there were still a number of important localities which had not been covered. The Indo-US Primate Project, a mega-project spanning several years, aimed to address the primary gaps in knowledge of primate distribution and decline. This was sponsored by the US Fish and Wildlife Service in collaboration with the Ministry of Environment and Forests, Government of India, and generated much new information about primates in the lesser known areas. This and the need for cooperation and collaboration between SAARC countries' biologists were also factors that led to the organization of the workshop.

CAMP stands for Conservation Assessment

and Management Plan. A CAMP workshop has several unique features, the first of them being that it is considered a 'process' rather than an end in itself. Species and habitats are under continuous human pressure, but at the same time there are initiatives to protect and improve habitats, and save species. Therefore, after assessing species on the basis of their population, distribution, habitat quality, and threats and categorizing them in any given year, it is quite likely that 3–5 years later, there will be a change—for better or for worse—sometimes a significant change. CAMP reviews, then, provide a method of monitoring whole taxon groups nationally, regionally and even globally. CAMP workshops also try to include specialists from a variety of institutions with a deliberate effort to avoid bias of any kind.

CAMP participants are encouraged to prepare for the workshop by sending information sheets ahead of time, even if they cannot attend, and to bring their field notes. Establishing that the primary goal is an objective, scientific output for the good of the species is intended to create an atmosphere of trust in which participants feel comfortable parting with information. One of the strengths of CAMP workshops is that a large amount of information which normally remains in the head of the field biologist, finds its way onto paper and into record so that management actions to protect species can be recommended. In many instances, facts held by individual field biologists may be insufficient for drawing a conclusion, but when combined with that of other field workers, provide enough data to assess a species applying the IUCN Red List Criteria, derive a category of threat and suggest recommendations for conservation action. The process of assessment of threat status relies on participants' knowledge of population decline and habitat deterioration



in specific areas over a particular time span as well as a variety of other factors.

The South Asian Primate CAMP had the endorsement of the IUCN SSC Primate Specialist Group, the IUCN SSC Conservation Breeding Specialist Group, the Ministry of Environment and Forests, the Regional Biodiversity Programme, Asia and the Indo-US Primate Project. It was sponsored by Conservation International, USA, other conservation organizations and zoological parks from USA and Europe. Fifty-five participants from 4 South Asian countries, USA and UK attended the 5-day workshop. Two more countries, Pakistan and Bhutan, could contribute to the workshop by exchanging emails throughout the exercise. Participants were primarily field biologists. However, primate taxonomist Dr Douglas Brandon-Jones, Primate Specialist Group Vice-Chair for Asia, Dr Ardith Eudey, trade expert, Manoj Misra as well as several foresters were also present.

A CAMP workshop is run by objective facilitators who attempt to provide a range of alternatives so that participants can select the method and means of going about assessing species. Everything is agreed upon through consensus in a plenary session, from the list of species to be undertaken to the additional subjects to be discussed. There are Ground Rules which are intended to insure that agreed goals can be achieved during workshop but these are sufficiently flexible to allow the addition of new features. The major work takes place in working groups, organized by taxon or region, with participants filling in detailed forms called Taxon Data Sheets.

New Studies, New Taxonomy

Every CAMP workshop is different, depending on the taxon group and the biologists who

study the taxa. In the case of the Primate CAMP 2002, the new taxonomy provided a challenge both to facilitators and participants. Participants were provided with complete reference material on the last few years of taxonomic nomenclatural evolution and then given an opportunity to discuss their options. After much discussion, participants decided to use the list given in a paper still under review by Brandon-Jones *et al.*, which is the output of a Primate Specialist Group taxonomy workshop held in 2000. It was felt by participants that the taxonomy proposed in this paper was most practical for them and also that, with the author being present, he would be in a position to explain subtle points accurately. Participants were more accepting of the *Semonopithecus entellus* being divided into subspecies, as per Brandon-Jones *et al.*, rather than species as last published.

In the case of primates, it was assumed that more information was available with field biologists. So a table for listing localities in more detail was included in the Taxon Data Sheets. This new feature proved to be very useful, particularly in view of the new taxonomy. By listing localities first and taking the help of the taxonomist, the field biologists who had not done their studies on the basis of the revised taxonomy, it could still derive an IUCN threat category for new taxa. Also they assembled a configuration of facts about primate species which, due to lack of opportunity to sit together and discuss, had never been collected before. The bulk of information available about primates in many different areas compared to other taxon groups, is in large part a reflection of the last decade of studies undertaken under the auspices of the Indo-US Primate Project in India, the Smithsonian Project in Sri Lanka, as well as smaller projects by other conservation organizations. This should prove en-



couraging to governments and conservation organizations to continue and enhance the funding of primate research as well as that of other taxon groups.

After listing localities and the other information required in the Taxon Data Sheet and deriving a threat category, participants were well armed to make recommendations for species conservation. In addition, participants in the different working groups drew up individual Species Action Plans for all threatened species and many others as well. During discussions of Working Groups, various issues arise which require discussion at a broader level, so, towards the end of a CAMP Workshop, 'Special Issue' Working Groups are formed. In the Primate CAMP, Special Issue Working Groups were formed for the following topics: Urban monkey problem; Funding field studies; Education and Species Conservation Action; *Semnopithecus entellus* taxonomy; and Captive breeding. During these discussions, Taxon Data Sheets for all 45 species and subspecies were assembled into a Draft Report and given to all participants for vetting when they return home. Once they return their comments and corrections, a Report will be brought out and distributed to participants, policy makers, politicians, wildlife and related agencies and institutions and—in an appropriate form—the public.

The 2000 Red List of Threatened Species had categorized 53 species and subspecies of South Asian primates. As a result of having many currently working field biologists from the range, it was possible to confirm many more threatened species than previously thought. Also with taxonomists subdividing the single

langur species into several subspecies reported in restricted numbers in specialized habitats, instead of one species of langur which was of 'Least concern', there are many distinct populations/subspecies of langurs which are threatened and require immediate protection.

In the workshop, 36 of the 45 species and subspecies of primates were categorized as 'threatened' as opposed to 22 of the 53 species of South Asian primates in the 2000 Red List. The final assessment will be ascertained only after receiving corrected Taxon Data Sheets. There are likely to be close to 6 species or subspecies of South Asian primates categorized as Critically Endangered, 24 Endangered, and 5 Vulnerable under the IUCN 2000 Red List Criteria. Ten species were not threatened or Data Deficient. Being assessed and ranked in any of the IUCN threatened categories implies a relatively high to extremely high risk of extinction in the near or relatively near future.

Also, the primate biologists were more accepting of lower subspecific taxonomic orders than specialists of other taxon groups, such as the chiroptera of which 130 bats were assessed in January at the species level only with a similar number of bat field biologists.

Wildlife agencies and conservation NGOs will use the information generated to make management plans and strategies for saving primates from extinction. Also the output from the workshop will find a place in the IUCN Red List of Threatened Species 2003. This will be an encouragement to local field biologists from South Asia to continue and intensify their studies, which have far-reaching and effective ramifications.



Monkey Menace—Who is Responsible?

Iqbal Malik

Of the 15 species of non-human primates present in India, only 3 are commensal, the Rhesus (*M. mullatta*), Bonnet (*M. radiata*), and the Common langur (*Semnopithecus entellus*). Of these, only the Rhesus macaque is the most aggressive, while Bonnets and langurs are comparatively less aggressive. Thanks to its wide distribution in North India, the Rhesus macaque is the reason for a majority of the attacks that have been reported from people living in the urban centres.

People from urban areas are more likely to be bitten than those living in rural areas, largely due to fact that they are ignorant of primate behaviour, and states like Delhi, Uttar Pradesh, Haryana and Himachal Pradesh are the worst affected, reporting the maximum number of cases. The reasons for this are many, namely: (1) Extensive urbanization (2) Increased encroachment of forests (3) Haphazard trapping of forest monkeys for biomedical research leading to chaotic fissioning and the related dispersal of monkeys to nearby human habitations (4) Decrease in the number of forest trees, that provide natural food to monkeys (5) Decreased availability of water in the monkey's natural habitat (I have observed monkeys moving between areas in search of

water especially during the summer months) (6) Decreased human tolerance to other life forms in the same environment (7) Increase in the population of Rhesus monkeys.

It has been estimated during 1980, that there were ca. 2 lakh Rhesus macaques in the country, with 30% being found in human habitations. But the present (1999) estimate of over 5 lakh Rhesus macaques of which ca. 55% being found in human habitations is an alarming trend. Consequently, there is also an increase in man–monkey conflicts and in the absence of a management plan of both forests and commensal monkeys, this problem of man–monkey conflict is only going to increase in future.

Although, there are no country-wide surveys for an estimate of the number of people bitten, the age and sex of those that are more likely to be attacked by monkeys, it can safely be said that there are increasing reports of monkeys biting humans in recent times. Based on the number of phone calls and letters that have been received by my office, a rough estimate of ca. 100 people being injured by monkeys every day is a truthful estimate, while the number would have been around 50 people 5 years back.



In 1996, Vatavaran collected data from 4 monkey-infested locations on people's attitude towards feeding monkeys and harassment of humans by monkeys (Table 1 & 2). We found that although monkeys of these areas harass all residents, office-goers, students and visitors, the degree of harassment varies between these groups. Residents are the worst affected, as the monkeys raid their homes and gardens, which leads to a vicious circle of aggression between the two resulting in the maximum number of cases of biting. The second category comprises office-goers who are also equally harassed, but are less likely to be bitten as most are adult males.

It is my personal observation that women and children are harassed and bitten more than men, as monkeys are more aggressive towards

those humans whom they think that they can easily dominate, and these are likely to be women and children. However, most children get bitten in their localities and not at schools. This is true, as in schools that are monkey-infested, children move around in groups (security in numbers), along with guards who have a *lathi* (long bamboo stick) in their hands. This deters the monkeys from attacking.

The screening of over 2,000 Rhesus captured in the Himalayan foothills of India and imported to the United States of America during the late 1970s revealed that over 40% of the macaques, tested positive for at least one potentially harmful pathogen (e.g. *Shigella*, *Salmonella* and Herpes B). This figure is disturbing given that the animals in question had been forest-dwellers and therefore had had limited exposure to humans.

Table 1. People feeding monkeys in and around Delhi

Habitation Type	Area	Categories	Percentage
Temple Town	Vrindaban, U.P.	Residents Pilgrims	78 98
Village and Historical Fort	Tughlaqabad, Delhi	Residents Visitors	45 75
Office Complex and VIP Residents Hospital	North Block, Delhi AIIMS, Delhi	Residents Office-goers Staff Patients Relatives	5 55 4 89
School	Air Force School, Tughlaqabad	Students Staff	– –

In spite of all this, over a 100 people (mostly children, women and the elderly) get bitten by monkeys every day, and are highly prone to contracting rabies. Doctors advise these victims to take ca. 10 injections of the anti-rabies vaccine, which costs ca. Rs 250/injection. This would amount to ca. Rs 2.5 lakh a day on just expenditure on the vaccine, thanks largely to our failure to check the monkey

Table 2. People harassed or bitten by monkeys

Category	% Harassed	% Bitten
Residents (Delhi & Vrindaban)	95.5	19
Pilgrims (Vrindaban)	30.5	3
Visitors (Tughlaqabad)	5	3
Office-goers (North Block)	88	2
Patients' Relatives (AIIMS)	20	2
AIIMS Staff	80	2
School Students	97	2

menace. In addition to this, the increase in the frequency of man-monkey conflicts contacts, also enhances the opportunities for the transmission of other potential disease agents like *Shigella*, *Salmonella* and Herpes B virus from monkeys to human and *vice versa*. As a consequence, I believe that greater commensalisms not only threatens the welfare of the monkeys involved, it also constitutes a public health problem that needs to be addressed.



A simple three-pronged formula to this problem is to put a ban on all trappings of monkeys from forests; increase the abundance of wild fruiting trees and waterholes in the remaining natural habitat for these primates and capture, quarantine, sterilize and relocate those monkeys that live in human habitations, to the Wildlife Sanctuaries of the respective states, which provide plenty of food, water and shelter for these monkeys.

The question that arises is—‘Why is this not being done?’ Wildlife management in India has to be more holistic in its approach, and more

attention needs to be paid to the issue of management of the wild but commensal species, besides large mammalian species. Of the major problems faced by the government is one posed by the animal welfare activists (the use of primates in biomedical research, in inhumane conditions). The other is the reaction of the masses (who have always regarded primates as part of our culture and religious belief). Hence for a successful and meaningful management to reduce and stop the man-monkey conflict, the government should be sensitive to the above-mentioned issues.



Monkeys in and around Jaipur: A Profile

P. S. Bhatnagar & R. Mathur



Jaipur is not only the capital of state of Rajasthan but also a famous tourist destination for domestic as well as foreign tourists and a centre for religious people, with many old temples located in various parts of the city. Two non-human primates, namely the Hanuman langur (*Semnopithecus entellus*) and Rhesus macaque (*Macaca mulatta*) have been recorded in and around the city of Jaipur.

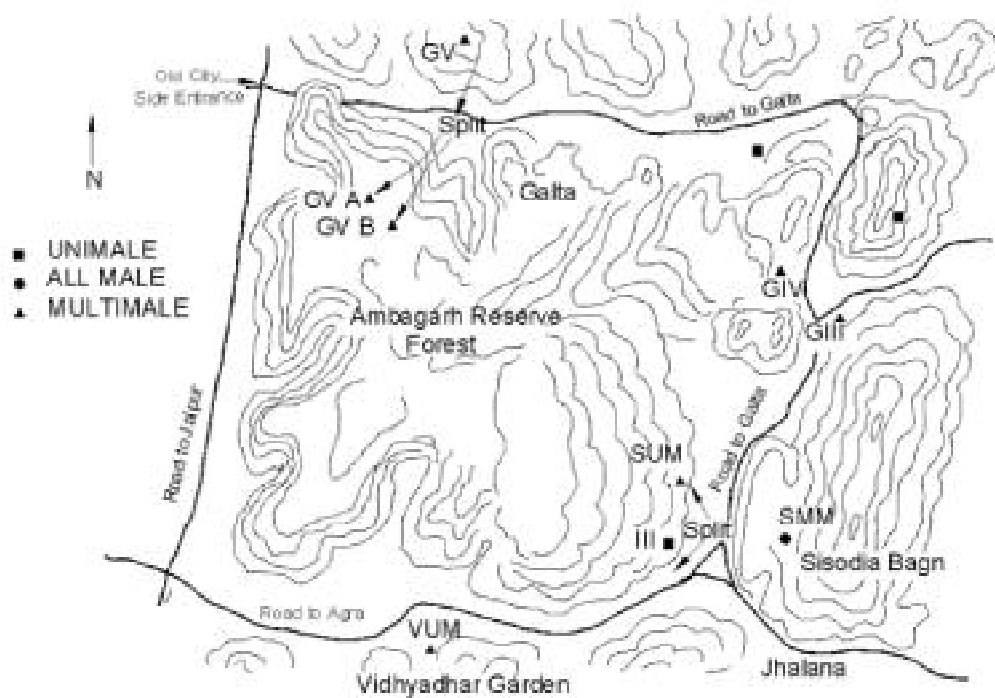
Knowledge of the population status of a species is fundamental to any long-term primate study. Therefore, during 1985–89, the population status of *Semnopithecus entellus* was determined in and around Jaipur. Since, Rhesus macaques and Hanuman langurs are sympatric species, their inter-specific interaction was also studied. In the next phase, behavioural studies were conducted at Ambagarh Reserve Forest, near Jaipur. This site was chosen due to its easy accessibility during all the 3 seasons and a sufficient number of easily observable langur groups, to study their behaviour. After a gap of 10 years, it was decided to study changes in the population status in the walled city, under the aegis of the Indo-US Primate Project.

During the study (1985–89), the number and group size of Hanuman langurs in the 4 different habitats (temples, residential areas, tourist centres, forest/village) in and around Jaipur,

totalled 35 groups (1,509 individuals) of which, there were 23 uni-male (group size ranged from 19–118), 3 multi-male (group size ranged from 26–53) and 9 all-male groups (group size ranged from 3–58). Forest/village habitat had the maximum group size because it provided more open space and greater food availability. The predators in these areas included medium-sized mammals like jackals and hyenas.

Groups were the smallest but maximum in number in the residential areas. The smaller group size could be due to less provisioning and limited and scattered food availability (over a vast area) in the form of roadside trees and house gardens. Temple and tourist centres had a bigger group size due to more provisioning and protection (religious belief), although the number of groups was lower as compared to residential and forest/village sites, as space is a limiting factor in terms of home range and territory for a group (Mathur & Manohar, 1994a). The age and sex ratio of langur groups around Jaipur showed a gradual decline in terms of adult female:Infant, adult female:juvenile and adult female:sub-adult ratio, which indicates a poor recruitment of breeding individuals in their population (Mathur & Manohar, 1994b).

After accessing the demographic data on langurs, behavioural studies were carried out at Ambagarh Reserve Forest, near Jaipur. In a



study on the takeover of a group by immigrant sub-adults and adults, it was recorded that there were fewer and less aggressive takeovers in areas with low population density (residential areas in Jaipur) as compared to high population density area (Ambagarh Reserve Forest, where population density of langurs is 6 times more as compared to residential areas). This suggests that population density of langurs rather than habitat disturbance (which is greater in residential areas) is correlated with takeovers (Mathur & Manohar, 1992). Studies on activity patterns showed that langurs at Ambagarh Reserve Forest were more active during winter when all the activities (feeding grooming and group movement) touched almost 3 peaks, while in summer the concentration of activities took place in the morning and evening. In the monsoons, langurs did not follow any set activity pattern (Mathur & Bhatnagar, 1991). In another investigation, results on the splitting of langur

groups were consistent with Hrdy's (1977) hypothesis that Hanuman langurs maintain a uni-male group structure and groups follow a 3-stage development, that moulds them into age-graded multi-male groups, followed by a split which once again brings in the uni-male grouping (Mathur & Manohar, 1990). Male juveniles were found to leave their natal troop only after a takeover either when chased by the new adult male or voluntarily (Mathur & Manohar, 1991). Quantitative work on mother-infant relationship in langurs using focal point sampling showed that there is a change in the behaviour of the mother and the infant towards each other as the infant grows up (Bhatnagar & Mathur, 1993).

We also had the opportunity to learn about the inborn capacity of langurs to revive their sick and its relationship with social dynamics, as group members attempted to revive only female conspecifics. (Mathur & Lobo, 1987). Langurs

were also found to be active during group protection by giving alarm calls to indicate predators like the wolf (Mathur & Manohar, 1986). Inter-specific interaction also took place between langurs and other species, for instance, langur infants and juveniles were noticed playing with rhesus infants and juveniles (Mathur & Manohar, 1992), while in another instance, langurs were observed eating ticks from dogs, lice from cattle and grasshoppers as these are sources of protein (Mathur *et al.*, 1990).

Since free-ranging animals could be in a state of flux, density of monkeys (rhesus and langurs) in the old city of Jaipur was re-estimated after a decade under the aegis of the Indo-US Primate Project. The density of monkeys (rhesus and langur combined) declined significantly from 426 monkeys/km², in 1988 to 230.04 monkeys/km² (Chi Sq. 58.52, df = 9, $p < 0.05$). The density of the rhesus reduced from 358.7 to 219.44 monkeys/km² and the density of langurs plummeted from 67.7 to 10.6 monkeys/km². This decline is due to the fact that the monkeys were recorded moving out towards open areas, away from the city due to increased anthropogenic disturbance or have been captured by municipal authorities to be released in the nearby forests. However, age–sex ratio has remained almost the same indicating that they have been reproducing satisfactorily. (Bhatnagar & Mathur, 1999).

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CITES Bushmeat Working Group Meetings

The first meeting of the CITES Bushmeat Working Group was held in Douala, Cameroon from 24th to 26th January 2001, having been formally opened by H.E. Sylvestre Naah Ondoua, Minister for the Environment and Forestry.

The meeting had been called by the Secretariat of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) following a decision taken at the 11th meeting of the Conference of its Parties, held in April 2000 at the UNEP headquarters in Kenya. At that event, the international community agreed that there was clear evidence that trade in bushmeat was being conducted, in some areas, in an unsustainable fashion and in contravention of national and international laws. The Conference was particularly concerned about the trade's impact upon highly endangered animals, such as elephants and the great apes, whilst recognizing that a wide variety of other animals were also being affected. At the Conference, Parties from the Central Africa sub-region volunteered to examine the issues involved with the aim of identifying solutions.

Distinguished delegates from Cameroon, Equatorial Guinea, the Republic of Congo and Gabon were present. Delegates from the other member countries of the Group, the Central African Republic and the Democratic Republic of Congo, were unable to attend. Chad attended as an observer. They were joined by representatives from international and national non-governmental organizations.

The CITES Secretariat, the International Tropical Timber Organization, the United Kingdom of Great Britain and Northern Ireland and the United States of America were also represented.

The participants heard reports from the Central African countries with regard to their efforts to date in researching the use of bushmeat and addressing the various issues relating to its trade. The meeting acknowledged that the use of bushmeat for subsistence purposes could take place in a sustainable manner but that the increasing commercialization of the trade was having serious impact on a range of species. Delegates complimented the four countries on their detailed work in preparation for the meeting. Non-governmental organizations made presentations relating to their projects being conducted in parts of Central Africa investigating, monitoring and tackling some of the issues. The Working Group welcomed the efforts made by such organizations, particularly where these involved local communities and partnership with government agencies.

During the course of its discussions, the Group identified the following as factors contributing to the negative aspects of trade in bushmeat: socio-economic issues; political instability;



legislation inadequacies; lack of information and education; unformed governmental policy; inappropriate natural resources management; adverse impacts of technology; commercialization of the trade; and shortcomings in institutional capabilities. Participants agreed that some issues, such as poverty, were outside the control or normal capabilities of wildlife departments and would require such long-term effort and very substantial financial commitment that it was impractical to focus on these issues at this time, although it was important that they be identified. Consequently, the Working Group attempted to prioritize the issues and discussed possible solutions.

The Group moved to establish a working plan for its activities and create action plans to tackle the factors that it thought required priority and which it believed could attract practical responses in the short term. For example, the Working Group agreed that the modernization and harmonization of law in the sub-region deserved close attention.

The Group also agreed that its work could provide important examples for other parts of Africa and to all Parties to CITES around the world.

The Working Group recognized that a multi-agency and partnership approach would be needed for the responses to be effective. In particular, it saw scope for work with the Convention on Biodiversity and the Food and Agriculture Organization of the United Nations in managing natural resources and maintaining food security. The meeting agreed to investigate potential sources of technical and financial assistance and called upon relevant international and national governmental and non-governmental organizations to support the CITES

Bushmeat Working Group: A detailed report of the first meeting, its outcomes and recommendations, will be submitted to the next meeting of the CITES Standing Committee in Paris, France, in June 2001.

The financial support of the United Kingdom of Great Britain and Northern Ireland and the United States of America was acknowledged as having enabled the meeting to take place. As the meeting closed, participants offered their sincere thanks to the Government and officials of Cameroon for their hospitality and work that had led to a very successful meeting. The Working Group agreed to meet again later in 2001.

The Bushmeat Working Group includes national representatives from Cameroon, Central African Republic, Democratic Republic of Congo, Republic of Congo (Brazzaville), Equatorial Guinea, and Gabon. These countries will serve as the case study area for identifying the scope of work and possible solutions. Results of their activities will be disseminated to other countries where illegal bushmeat commerce endangers species survival: Benin, Côte d'Ivoire, Ghana, Republic of Guinea (Conakry), Kenya, Liberia, Mali, Niger, Sierra Leone, Togo, Zambia.

Source: <http://bushmeat.net/cites-01-01.htm>



Illegal Trade, and Utilization of Primates in India

Alrar Ahmed

Introduction

The world market for wildlife and its derivatives is surprisingly large, worth 20 billion US\$ annually; of which at least 30–40% is illegal. In India except for some trade studies on certain large mammal species such as the tiger (*Panthera tigris*), elephant (*Elephas maximus*), rhino (*Rhinoceros unicornis*) and the musk deer (*Moschus moschiferus*), trade in other mammals and their parts has received little attention. India is home to 15 species of non-human primates, with all of them being recorded, in use one way or the other. Before the ban on export in 1978, India was the largest exporter of live Rhesus macaques (*Macaca mulatta*) to international markets. Despite the ban on hunting, trapping and selling of primates, poaching and trade continue in several parts of the country. Among the several live mammals in trade, primates comprise bulk of the trade in India. This paper focuses on the trade and utilization of primates in India.

International Trade

Annual international trade is reported to include 40,000 primates. According to Fitzgerald (1989), globally, as many as 80–90% of the primates used in biomedical research come

from the wild, with USA being the largest importer of primates in the world with imports of up to 13,000–17,000 live animals a year. However, recent studies point out that 70% primates used in research are from breeding farms while the rest are from the wild (Malik, 2000). The major countries of export are Indonesia and the Philippines. The international trade in various monkeys, lesser apes, Chimpanzees and Orangutans is accelerating the decline of these animals to the point of near extinction. There is a huge market for primates as pets in many southeast Asian countries.

Relevant Legislation

According to the Indian Wildlife (Protection) Act (WPA) of 1972 (as amended in 1991) all Indian primate species are protected. The export of primates is banned and import is controlled by the Convention on International Trade in Endangered Species of Fauna and Flora (CITES) regulation. All Indian primates are included in CITES and WPA (refer to A.K. Gupta in this issue). The Prevention of Cruelty to Animals Act, 1960, controls cruelty on monkeys and experiments with them. Killing, buying and selling any kind of primate can entail a fine of Rs 25,000 and imprisonment up to 7 years or both.



Methodology and Study Areas

This paper is based on a mixture of first-hand evidence collected during my live bird trade study of various Indian animal markets between October 1994 and March 2000. This communication also relies heavily on anecdotal and first-hand knowledge of the animal trade culled from interviews with animal traders, former exporters, zoo-keepers and primatologists. Published information, tour reports of the Trade Records Analysis of Flora and Fauna in Commerce (TRAFFIC India) investigators, informants and newspaper reports have also been considered.

Trade and Use of Primates in India

Regular hunting of primates for food is prevalent in the northeastern states of Arunachal Pradesh, Assam, Mizoram, Nagaland, Meghalaya, Tripura and Manipur. Hunting of primates is also prevalent in the Western Ghats. As a by-product of hunting, capture of young ones for pet trade is common. These orphaned animals are sold to visiting animal sub-dealers who in turn sell them to organized dealers in Patna, Kolkata and Bangalore.

In India, primates are primarily captured or poached for the following 8 reasons:

1) Bio-medical research: Primates are captured and traded for use in experiments in bio-medical research. Among animals experimented upon in Indian labs, monkeys form ca. 3%, of which 90% are Rhesus macaques, followed by the Hanuman langur and Bonnet macaque (8%), while the remaining 2% comprises other primate species (Dr Iqbal Malik, Primatologist, *pers. comm.*). The experiments range from infectious diseases to animal behaviour, with the Pig-tailed macaque in current demand for HIV (AIDS virus) research by medi-

cal laboratories (Srivastava, 1999). Rhesus macaques are used in investigations on toxicology, organ transplant, testing of drugs, tissue transplant, liver disease, caloric studies, drug abuse and several other diseases. Field interviews with traders suggest that several hospitals and laboratories obtain primates from dealers based in Varanasi and Lucknow.

2) Zoos: Capture of primates for zoos was common until the last 4–5 years, before the closure of travelling zoo and mini zoos. This caused the trade in primates to subside, as otherwise wild caught primates were regularly supplied to these zoos. However traders still report the request for purchase of endangered primates by certain zoos in India and abroad. Almost all Indian species of primates including endangered species such as the Golden langur, Hoolock gibbon, Lion-tailed macaque, Slow loris, Slender loris are all known to have come from animal dealers and zoo brokers. The main suppliers of primates to most zoos in India are the *Mirshikar-toli* traders in Patna (Bihar) and Burdwan (West Bengal).

3) Pets/Private collections: A large number of people are known to keep primates as companions. The most common species kept as pets are the Hanuman langur, Rhesus and Bonnet macaques and the Slender loris. In the Sonepur fair, each year the author recorded 80–100 young of the Hanuman langur and Rhesus macaques on sale. Even endangered species such as the Hoolock gibbon has been recorded as kept as pet. Given below are some records:

- The author recorded one individual of this in Allahabad in 1999 and one was reported from Vadodara, which was later seized. The accused reported to have purchased this from Mumbai's Crawford market (Snehal



Bhatt, People for animals, Vadora *in litt.* to TRAFFIC India, 1997).

- Stump-tailed macaques are commonly kept as pets in Nagaland and Hoolock gibbons in most of the northeastern states (Srivastava, 1999).
- One Hoolock gibbon kept as a pet was recorded in 1998 between Namdapha and Dibrugarh highway on the Arunachal–Assam Highway (Tariq Aziz, WWF India, *pers. comm.*).
- Nilgiri langurs are often kept as pets near several Protected Areas in Tamil Nadu and its neighbouring states (Arun Kumar, *pers. comm.*).
- Young Rhesus macaques are trained and used as watchmen by truck drivers, who tie them at the back of a truck or a carrier to guard their goods. Outsiders trying to pick anything would result in the monkey growling at the intruder, making the driver aware of such an activity. This kind of demand is common in the animal markets of eastern Uttar Pradesh and Bihar. On the Lucknow–Sitapur road, the author recorded such instances within a span of 3 hours during a field survey in 1994.
- On 2 occasions nearly 200 young Rhesus macaques and Hanuman langurs were recorded for sale as pets in the famous Sonapur fair in Bihar (November 1995 & November 1999). The author also recorded a minimum of 200 Rhesus macaques for sale in 12 surveys in *Nakhas* bazaar in Lucknow, *Baheliya toli* in Varanasi, *Mirshikar-toli* in Patna, *Hathibagan* market in Kolkata and *Kanta toli* in Ranchi between 1994 and 2000. Often Rhesus macaques were recorded for sale in Delhi's Jama Masjid bird market (Dr Iqbal Malik *pers. comm.*).
- In 1999, on 4 occasions, the author has recorded 17 Slender loris for sale, at Shivaji market in Bangalore, Crawford market in Mumbai and in Pakshirajpuram in Hunsur near Mysore, Karnataka.
- Malik *et al.*, (1997) recorded the sale of 3 Nilgiri langur as pets, the prices ranging from Rs 400–1,000 along with one Bonnet macaque for Rs 100 at Ukkadam market in Coimbatore.
- In Pollachi Malik *et al.*, (1997), recorded the sale of a Lion-tailed macaque for Rs 1,200, while Slender loris has been recorded in Coimbatore (Areendran, G., WII *pers. comm.*) as pets.
- Animal traders in Patna, Ranchi, Kanpur, Delhi, Lucknow, Varanasi, Bangalore and Mumbai claim to supply young Rhesus, langur and loris anytime at an advance notice.
- Hanuman langur are used by some Hindu priests as pets for religious purposes.
- In Umanada Island in Guwahati, the introduced Golden langur troop is reported to be of the lineage of a pair brought by a priest (Mohammad Firoz, Secretary Aryanak, Nature Club, *pers. comm.*).

4) Street performances: *Madaris*, *Kallanders* and sometimes *Jogi* and *Nath sapers* are some tribes that use the Rhesus macaque, Hanuman langur and Assamese macaque for their livelihood by teaching them simple tricks and using them in roadside performances and at tourist spots. A large numbers of young Rhesus are captured for this purposes. Field surveys by the author indicate that a minimum of 1,000 families in India earning their livelihood from such acts. In the south Indian states, roadside astrologers use Slender loris for taking out fortune cards. During 2 visits to



Bangalore in 1999 and 2001, the author encountered 3 individuals used for this purpose. Similarly Slender loris were also recorded in Thiruvananthapuram (R V Singh, Assistant Director, Wildlife Preservation). Sometimes Nilgiri langurs are also used for street performances in South India.

5) Medicinal value: Although the pet trade consumes a large number of individuals, trade for local therapeutic purposes is prevalent in some parts of India especially the northeast. Species used for medicinal purposes are the Assamese and Rhesus macaques. Some treatment methods recorded by TRAFFIC India are:

- *Cure for rheumatism by eating a monkey brain from a live animal.*

For this purpose, a special table with a pre-fabricated holding device is used. The monkey's head is introduced through a hole on the top of the table and a chain tied to the bottom part of the table holds its legs. Boiling water is then poured over the head and face of the primate causing extensive scalding and peeling away of the fur and skin. A sharp rap with a small hammer cracks the skull and the 'doctor' pours several tubes of ointment into the skull. The patient who is seated at the same table inserts a spoon into the cranium of the monkey and eats the brain, alternately mashing and mixing, with the drugs therein (Vivek Menon, WTI, *in litt.*, to TRAFFIC India, 1993).

- *Cure for Asthma*

For this, the patient drinks the monkey's blood. The clientele of such clinics are mainly tribal; although tribal in a loose form means 'of tribal origin'. However clients include wealthy businessman to labourers who swear by the animal medicine.

Srivastava (1999) also mentions that the use of primates for their supposed medicinal value is common in the northeastern states. Tribes such as *Chakmas* and *Riangs* from these states, who do not eat meat, use primate body parts in traditional medicine for treatment of asthma, fever, body ache and abnormal blood pressure. Phayre's langur is hunted in areas around salt springs where the species has large gallstones because of the limestone. These gallstones (*bezoar*) are prized for their medicinal value by the Chinese (Srivastava, 1999).

6) Meat: The consumption of primate meat by certain tribal and non-tribal communities is still prevalent in the northeast and eastern India. According to Srivastava (1999) the main reason for hunting primates in the northeast appears to be protein requirements. He further mentions that many tribal cultures consider primates as a perfect source of meat and many prefer primates to larger and more traditional game. Starting from Assam, to Nagaland and Mizoram, all locally found primate species are poached using guns, bow and arrows tipped with some plant poison. The utilization of primates for food varies from area to area. For instances in Nagaland, Manipur and Arunachal Pradesh, Hoolock gibbon meat is considered a delicacy, while this species receives less attention in Meghalaya, Mizoram and Assam. Phayre's langur is hunted for food by *Lushai* and *Mizo* tribes in Mizoram and Tripura (Srivastava, 1999). Similarly Srivastava (1999) mentions that the Capped langur has been indiscriminately hunted to the brink of extinction for food almost in its entire distribution range. Meat as a by-product of primate hunted as agriculture pest is also common in the northeastern states (Srivastava, 1999). Some instances are:



- From the Kokrajhar forest in North Lakhimpur, the author recorded a Capped langur for sale in a weekly village market in January 2000. While on a weekly Sunday '*haaf*' (weekly market), 14 poached Capped langurs were recorded for sale in Seojuli near Kakui Reserve forest in North Lakhimpur in Assam (Bikul Goswami, *pers. comm.*).
- It has been quite frequently reported that poachers from Nagaland come to Assam to kill monkeys, transport the meat to Nagaland where it is sold for Rs 80/kg. Even the endangered Hoolock gibbon is sometimes killed by poachers at the Hologapar Wildlife Sanctuary in Jorhat district for meat.
- In South India, the author recorded the sale of primate meat in the Aangamali and Malayatur villages near Cochin. In this region, poachers hunt the Nilgiri langur and the endangered Lion-tailed macaque.
- In the states of Bihar, Jharkhand and Orissa, the *Makariya* (Makar = bandar = monkey) tribe is totally dependent on the Common langur and Rhesus macaque for food. During a visit in the Bursua and Khandhar mines in June 1995, the author witnessed the activities of this tribe. *Makariyas* move in family groups of 15–20 members in the forested areas. The men are excellent nomadic primate hunters and the women are skilled in making ropes from tree barks. Groups of eight to ten people visit secondary jungle in search of primate troops. On seeing a group of langurs or rhesus they first try to locate an isolated tree. The primates are then driven towards this tree by the tribe members chasing the monkeys to the vantage point and by climbing the nearby trees. Several hanging nets surround this vantage tree. A few tribe members climb this

tree to drive the monkeys down towards the net, and using long powerful sticks, kill the animals. The head is cut and the skin is peeled. Some meat is consumed the same evening while the rest is dried for lean periods. Tribes are able to capture 4–5 primates by this method during a trip. The juveniles are sold as pets to the peripheral villagers and to visiting truck drivers. There is a common belief about this tribe as reported by the local villagers—this tribe is so wild that it may kill and eat its old members. Fearing such stories no villager wants to confront these tribe members. However investigations during my trip suggest no such practice, though it seems that old members may starve to death, as they are not taken care of by the group once they are quite old and unable to move with the clan.

7) Pelts: The pelt of the Capped langur is commonly used for making the casing cover of swords locally known as '*dhow*' in Arunachal Pradesh. The author counted a minimum of 40 such casing covers within one day of stay in Itahnagar in Arunachal Pradesh in January 2000. In the Garo hills in Meghalaya, pelts of the Capped langur are used for making caps (Srivastava, 1999). In eastern India *Makarias* sell the Rhesus macaque and Hanuman langur membranes to drum makers for a sum of Rs 15–30/skin. Malik *et al.*, (1997) recorded the sale of 2 Nilgiri langur skins at the Karmadai area and of a stuffed Slender loris at the Kinathukadavau area, near the Nilgiri Biosphere Reserve in South India. Sale of hoolock gibbon pelts was recorded in Roing in Dibang Valley, Arunachal Pradesh during 1995 (Areendran, G., Will, *pers. comm.*).

8) Witchcraft and Black Magic: Skulls of various species of primates are hung outside



tribal dwellings in Arunachal Pradesh and other northeastern states to ward off evil spirits or simply as objects of ornamentation. For instance the *Adi* tribe of Arunachal Pradesh displays monkey skulls at house entrances. Similarly the *Mizo* tribes of Champai district decorate their walls with monkey skulls (Srivastava, 1999). Charms prepared from dismembered digits of a monkey's paw strung together on a thread are believed to treat paralysis (Vivek Menon, *WTI in litt.*, to TRAFFIC India, 1993). Keeping Hanuman langur bones subjected to black magic rituals is considered auspicious and brings recognition. Similarly bones of a Rhesus macaque if kept in the house after performing black magic on them prevent any ill omen visiting the house owner. An eye of the Hanuman langur worn in amulets is believed to increase courage and strength (Tantrik Bhel, *pers. comm.*).

Trade Areas and Routes

The main organized primate trade centre where most stock for retailing reaches are *Mirshikar-toli* in Patna (Bihar); *Baheliya-toli* in Varanasi, Bagahi in Kanpur and Nakhas bird market in Lucknow (Uttar Pradesh); Dhuvraj diggi in Burdwan, Dangiapara in Siliguri and Narkul Danga in Kolkata (West Bengal); Bijohnagar and Duphdara villages on the Assam–Meghalaya border, Shivaji market in Bangalore (Karnataka); Crawford market in Mumbai (Maharashtra) and Chowk market in Hyderabad (Andhra Pradesh). Traders from these areas especially from Patna, Bangalore and Calcutta offer to supply any species of primates on order and have a well-organized nexus with all sub-dealers and primary collectors.

Patna's *Mirshikar-toli* is the most famous animal trade centre with an equally active trade

centre in Kolkata that has since shifted to Burdwan. Most of the stock from the north-east reaches either Patna or Burdwan via Siliguri. The other trade routes are from parts of Assam and Meghalaya to Nagaland and across the border with Myanmar for Southeast Asia with stocks stored between the Guwahati and Shillong highway. Hoolock gibbons are trapped in Meghalaya, North Cachar, Hameran in Arunachal Pradesh, Goalpara and the Garo Hills. Previously they were reported and stored in Guwahati, but are now kept in Boko, Bijohnagar and Duphdara and villages on the Assam–Meghalaya border. In Boko and Bijohnagar the author recorded 4 individuals of the Stump-tailed macaque in a trader's house. Similarly one Hoolock gibbon was recorded at Bijohnagar in 1996. Golden langurs come mainly from the Bhutan border and from pockets in Assam. In mid 1998, TRAFFIC consultant reported a few Golden langurs for sale at Guwahati, (Saumyadeep Dutta *in litt.*, to TRAFFIC India, 1998). From Patna, the stock reaches Kathmandu (*Bagh Bazaar*) from where the animals go to Bangkok (Southeast Asia) and markets in the Middle East. This is evident from the 3 live Clouded leopard cubs seized from a Patna dealer in Kathmandu in the mid 90s (Diwaker Sharma *pers. comm.*).

During the author's visit to Tripura, he was informed by local wildlife officers of the possibility of some primates reaching Dhaka in Bangladesh via the Tripura–Bangladesh border as Tripura shares 80% of its border with Bangladesh (Rohiming Linana, *Pers. comm.*). Even species such as Phayre's langur are smuggled through this route. Traders report that the primates reach Bangkok, and other foreign markets via Dhaka. This needs further verification.



Baheliya-toli in Varanasi is a famous trade supply area of Rhesus macaques to Indian laboratories and hospitals. Nakhas market in Lucknow is also known for this. Traders in Bangalore's Shivaji market were quite active until the last 2–3 years in supplying southern primate species like Slender loris to zoos and dealers throughout India. (M.K. Srinath, WWF, Bangalore, *pers. comm.*).

Hardly any study has been carried out on the quantum of trade of or the impact of trade on a primate species. Except for the Rhesus macaque that has spread all over after the ban on its export, most of the primate species continue to be threatened.

Prices

The price of primates recorded during my survey ranged from Rs 30 to Rs 10,000. A Rhesus macaque can sell for Rs 30–300. The Golden langur and Hoolock gibbon can fetch upto Rs 10,000 in the domestic market or zoos, while international prices can be higher. In a quotation of an Indian (Rampur based) animal dealer to an animal firm in Europe, the price of Rhesus infant was quoted at US\$ 80 per individuals (TRAFFIC Europe *in litt.*, to TRAFFIC India 1995). Current market prices for various species depend on the place, the availability and the degree of awareness. Stump-tailed macaques and Assamese macaques can sell for Rs 100–300 each. Similarly, Hanuman and Rhesus macaques have a unit retail price tag of Rs 300–800 for research lab and pet suppliers. The author recorded a price of Rs 50,000 for an albino Rhesus macaque at a trader's premises in Patna in 1995. Malik *et al.*, (1997) recorded the price of a live Nilgiri langur ranging from Rs 400 to 1,000, while the Lion-tailed macaque was recorded with a price tag of Rs 1,200.

Seizures

There are very few reported seizures of primates in India as 2 of the commonly found primates species namely the Rhesus macaque and the Hanuman langur are considered pets in several areas and in general, people do not consider anything wrong in revering captured animals. The Hindu religious sentiment attached to these 2 species makes them common pets. However, in early 1992, a consignment of primates was seized in Kumarpara market (Guwahati). The seizure comprised a Hoolock gibbon, 2 Stump-tailed macaques, and 2 Slow loris (Dr Anwaruddin Choudhury, primatologist, *pers. comm.*). In addition to this, some more primates were seized the same year, and included, 2 individuals each of the Golden langur and the Hoolock gibbon, along with a Leopard cat (*Felis bengalensis*) and some Hill mynas (*Gracula religiosa*) (Asim Chatterjee *in litt.*, to TRAFFIC India, 1993). In 1998, one Stump-tailed Macaque was seized from a mobile zoo at Tinsukia (Dr Anwaruddin Choudhury primatologist, *pers. comm.*). On 25 March 2001, 2 Bonnet macaques were seized from a bird shop in Crawford market, Mumbai (S. K. Neeraj, Regional Deputy Director (Wild-life) *in litt.* to TRAFFIC India, 2001). In South India particularly in Bangalore, seizures of Slender Loris are common. The animals are then sent to local animal shelters (Salim, People for Animals, Bangalore *pers. comm.*).

Discussion

Trade and the impact of poaching on wild populations of primates in India have received little attention. However, the inclusion of all Indian primate in CITES, is in itself an acceptance of trade in these species. Undoubtedly there has been an increase in the Rhesus macaque population after the ban



on export in 1978. Nevertheless, recent evidence suggests that poaching, habitat destruction and fragmentation has led to the decline of several primates that are on the brink of extinction. Srivastava (1999) mentions that 'Primate hunting is difficult to control as in many cases it is part of a traditional way of life and also because much of it occurs in remote areas.' He further says that the use of primates in medicine can pose a serious conservation problem. There is an urgent need to document trapping techniques for use in wildlife management. Documentation of traditional trapping techniques for translocation of problematic species such as the Rhesus macaques will not only help reduce man-animal conflicts but also rehabilitate traditional trappers and their skills. Laboratories must use primates from captive-bred centres as this will reduce the demand for primates from the wild (Iqbal Malik, *pers. comm.*). A systematic study of live mammal trade including primates is recommended, and it is also essential to gather similar information from Bangladesh and Nepal to get a more comprehensive picture of this very sensitive and underground trade.

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Traditional Trapping Techniques of Primates in India

Rajat Bhargava

Introduction

Animal trapping is carried out for a variety of reasons that range from pet trade, zoo trade, medicinal, bio-medical research, street performance to their ornamental value. Trading in animals continued legally or illegally in India and has been an issue of concern since the Wildlife Protection Act, 1972. Amendments have been made from time to time to this act with regard to permissible trade and trapping. For instance, the total ban on the trapping and export of Rhesus macaques came into force in 1978. Before 1978, a legal quota of 45,000 Rhesus macaques and 5,000 Hanuman langurs were allowed for export under the Exim policy in the early 1970s (Dr M. K. Ranjit Singh *pers. comm.*). The numbers trapped were much more to compensate for mortality during transportation. The organized trade and market supply of primates involving various trapping methods for primates have been traditionally used for generations. A total ban combined with environment activism has resulted in the phasing out of the trade and trapping methods. After three decades of total ban on primate exports, the trade is still practised in a covert manner by some tribes, traditionally engaged in this profession.

Background

The total ban on Rhesus has resulted in a phenomenal increase in their populations, and being a species that is well adapted to human habitation, this has consequently resulted in an increase in man–monkey conflicts. In an attempt to translocate problematic monkeys, I was assigned to carry out a survey of monkey trappers in Uttar Pradesh and help in translocating these macaques. Since the majority of monkey exports was from the Delhi airport (Dr M.K. Ranjit Singh, Member IBWL, Ashok Kumar, Trustee WTI and Iqbal Malik, primatologist *pers. comm.*), the majority of trappings took place around the state of Uttar Pradesh. The present communication is based on many field trips with traditional animal trappers and my hands-on experience with a monkey translocation project at Vrindavan, Uttar Pradesh during 1996. Using traditional trappers, I successfully trapped nearly 600 monkeys within a week. Data on trapping techniques was collected during numerous field trips with the traditional trappers of monkeys. This communication briefly describes the methods used for trapping primates in India by traditional communities engaged in wild animal trapping. It is an attempt to document indigenous trap-



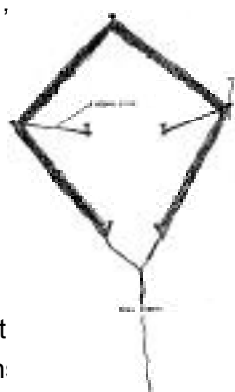
ping techniques that can be used for management practices.

Prior to the ban on export, preliminary surveys suggested that the main monkey trappers are based in Kannauj, Lucknow, Kanpur, Agra, Bareilly, Rampur and Varanasi. Two tribes namely *Kanjjar* (Hindu, hunters–gatherers) and *Pathami* (or *Jabjalies*—muslims, fishermen of origin) were associated with monkey trapping. However, trade at the middle level was handled by the *Mir-shikar* and *Baheliya* communities who in turn provided the stock to exporters. Local trapping by other tribes was also common and the expertise varied from tribe to tribe. *Makariyas* (*bandarwallas*) in eastern India also catch monkeys for food.

The commonly used methods in primate trapping are:

Bamboo Walk-In Cages (*Jhafri Method*)

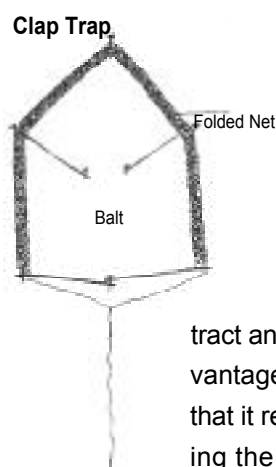
When export was legal, bulks of Rhesus were captured using walk-in cages built of bamboo. A rectangular-shaped cage ca. 3 x 2 x 2.5 m with an iron (manually operated) door was used. Monkeys were pre-baited in this bamboo cage and trapped by the manual shutting of the doors. The efficacy of this method was very high as the trappers could catch upto 15–20 animals from a single troop. This method was widely used by the *Pathami* trappers of Uttar Pradesh mainly in Kanpur, Lucknow, Kannauj and Agra. The advantage of this method is that it does not require manual handling of the animal as the trapped monkeys can be easily shifted from one cage to another. This is best used in human habitation:



buildings, public locations and market places. The disadvantage of this method is that some forested species may not be trapped with this method. Generally groundnuts and fruits are used as bait. Sometimes a young monkey is tied/kept as a decoy inside the cage.

Hut-Shaped Net

This is a modification of the clap trap method used for trapping birds and is widely used for trapping primates from forested areas. The net



is placed with the help of pegs and is operated with a pull-string.

The net can be camouflaged with mud and works best for any species. Food is used as a bait to attract animals.

The only disadvantage with this method is that it requires manually shifting the trapped animal from the net to the cage. The

Kanjars and sometimes *Pathmis* used this method in the forested patches of western Uttar Pradesh and Uttaranchal.

Manual Trapping

Trappers trained in handling a live primate can catch common primate species by using bait kept in their hands. On seeing a fairly domesticated monkey troop, the trapper feeds a monkey. Once the animal is confident of accepting bait from the trapper's hand, the trapper puts a peanut kernel between his central fingers and lures the animal. When the animal tries to take the peanut, the trapper catches the monkey by the hand and quickly shoves the trapped animal into a gunny bag placed under his left armpit. Trappers using this method are

especially experienced as the free-ranging Rhesus or langur can attack. This method is used for selective trapping of young/sub-adult primates for specific purposes. *Jabjali* and *Pathami* trappers are best known for trapping monkeys using this method in Lucknow, Varanasi and Kanpur.

Hand-Clasping Device (*Shikanja*)

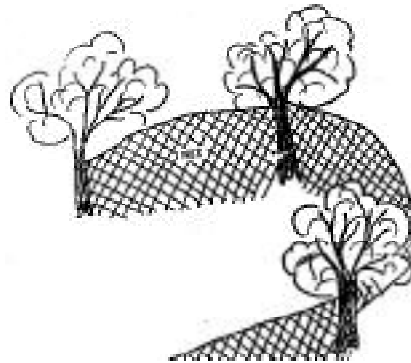
This method is used for catching a single monkey. An automatic hand-clasping device with fruit as bait is placed at a vantage point. As the animal tries to pick up the bait, it is caught by its hand. The animal needs to be quickly removed; otherwise, there is a risk of the wrist of the trapped animal getting injured. The trapped animal also attracts many free-ranging animals by its agony calls, which makes trapping those animals more difficult. This method is used by the municipal corporation officials to tackle the monkey menace and often by *Madaris/Kallanders* (people who use monkeys for street performances).

Drive Nets (*Bhabhariya Jal*)

Full-time animal trapping communities traditionally use this method. Communities such as the *Kanjars*, *Makariyas* used this method to catch Rhesus and Hanuman langurs in North and East India. Huge nets are hung and monkeys are driven towards the net by a group of six or more people. On selecting a vantage point, generally an isolated tree, monkeys are driven on to the tree, which is encircled by the net. This method is generally followed in forested areas where a mass capture is targeted. Animals are likely to get injured during this method. This method was practised in the Kumaon foothills by the *Kanjjaar* community, but now it is also practised by the *Makaryas* in eastern India.

Collection of Young Ones

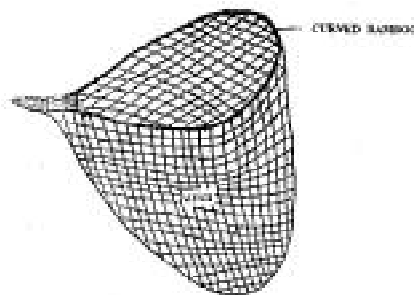
Pet traders prefer young primates. Some young primates are collected after killing the mother. The poached adult is used for meat while the



young are sold as pets. In fact, most of the northeast primate species are generally obtained after killing the mother.

Ring Net

A net is attached to a folded bamboo ring that is quickly thrown over the Rhesus macaque. Some communities in Tamil Nadu use this, while its use has also been reported occasionally from Kanpur.



Using a Light Source

The Slender loris is captured from feeding trees at night using a strong light beam. Once the animal is located, the branch on which the animal is sitting is cut using bamboo poles fitted with a hooked metal knife, and the animal brought down. The *Hakki-pukki* and



Narikorava tribals in South India generally do this.

Discussions

Trapping of animals is generally linked to trade and poaching and hence is a taboo. Three decades of total ban has forced the traditional trapping methods into neglect and the expertise of these techniques lies presently with only a few people who are engaged in illegal trapping. On the one hand, the total ban poses the problem of livelihood for these people, while on the other there is the problem of man–monkey conflict. Modifications to some traditional methods can efficiently help in the management of problematic monkeys and help in their conservation. The trapping methods have mostly been passed from generation to generation but remain largely undocumented. During the survey it was found that most monkey trappers were in the age group

of 60–70 years with very few youngsters involved, as there is no future in this trade. It is therefore recommended that a proper step-wise documentation of traditional trapping techniques of primates and other animals be undertaken as this is an important conservation tool. With radio-telemetry being used in the study of several species, these methods and practices can be useful in the capture of primates.

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Leading Exporters and Importers of Primates (Number of Primates)

Leading Exporters	Total	Leading Importers	Total
Philippines	12,502	United States of America	21,657
Indonesia	10,569	United Kingdom	5,811
United States of America	5,725	Japan	4,795
Guyana	5,305	Former USSR	2,953
Kenya	5,074	The Netherlands	2,786

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Pig-Tailed Macaque (PTM)

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Golden Langur(GL)

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Crab-Eating Macaque(CEM)

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